Heating and Ventilating

For Engineers and Contractors Controlling the Design, Specification, Installation and Maintenance of Heating, Ventilating and Air Conditioning

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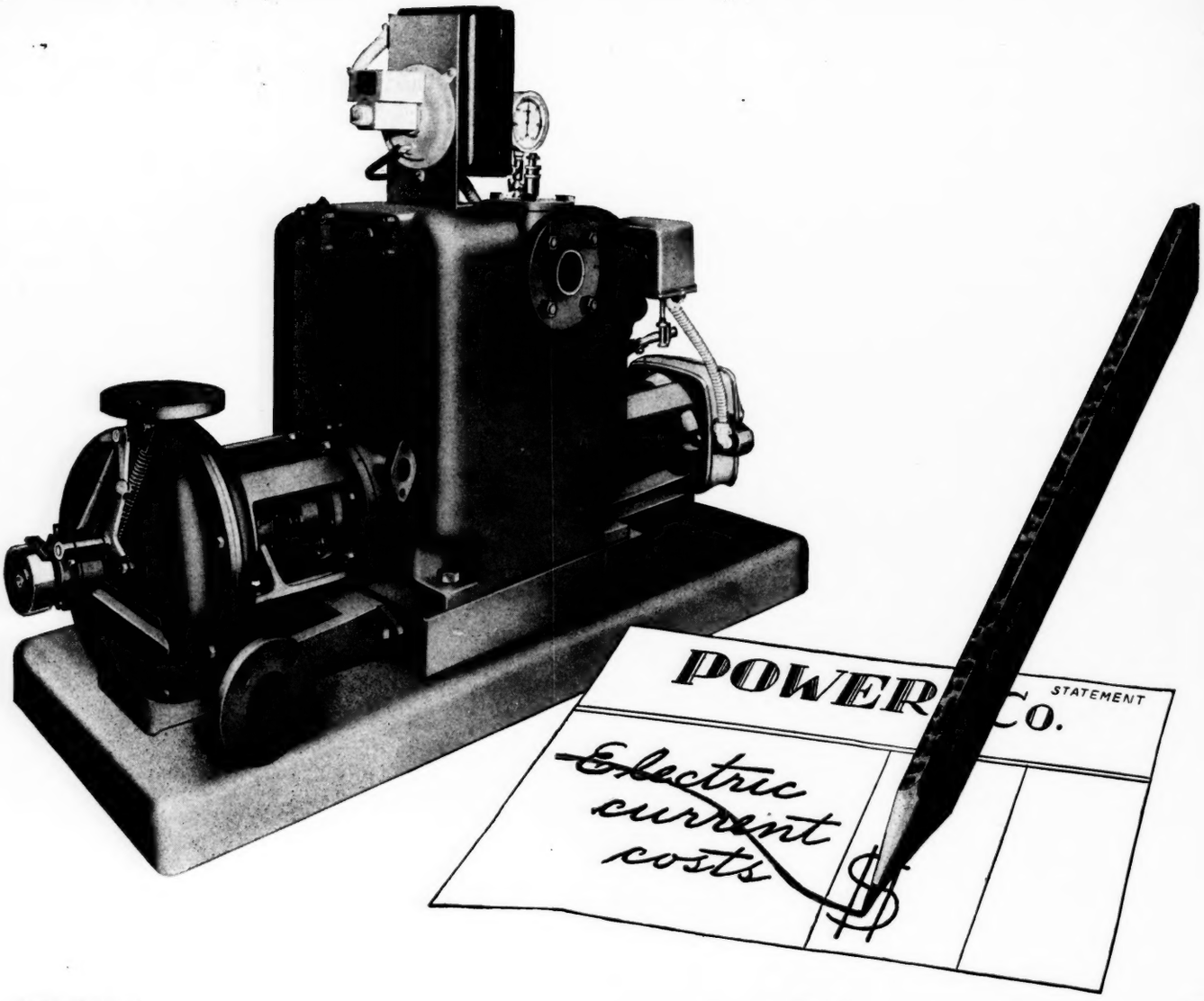

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Engineering Economy in Hospital Design

By CHARLES F. NEERGAARD†

IN the last half century the American hospital has reached a position of world wide preeminence. The architect and engineer in their buildings and equipment have more than kept pace with the rapid progress of the medical profession in diagnosis and treatment. We may dissent, however, and not a few of us do, from certain of the principles and standards which have come to be widely accepted as essential in the modern hospital.

The evolution of the hospital is a matter of many small steps up a very long ladder. Its plant has come to be about as complicated as a battleship. The Navy, however, has a continuity of policy and experience in planning which makes it possible, in theory at least, to adopt all accepted improvements and avoid previous mistakes in each new ship, whereas each new hospital is an insular and largely unrelated problem.

It has seemed at times that the complexity of hospital technical equipment has proven contagious and that some of the eminently practical engineering fraternity have become infected with a complexity complex which has spread into the fundamentals of the plant. There has been a tendency to exaggerate factors of safety, breakdown reserves, automatic controls, and refinements, seemingly on the theory that because it is a hospital practically everything which art and science have accomplished in mechanics is appropriate. Equipment which might be suitable in the home of a millionaire or in a bank building (before the depression) has been included in the hospital's compendium. Much of this the hospital neither needs nor can afford. Few of the uninitiated realize the exorbitant cost of buying and maintaining waste space, excessive cubage, special fixtures, complicated gadgets, architectural, structural and engineering features, the real value of which is negligible in furthering the hospital's work.

In the light of the difficult transition period which lies ahead, we may well pause and take count of stock. Today the hospital situation is critical. Pernicious financial anaemia is epidemic. Many hospitals have succumbed and closed their doors. Many find themselves burdened with over-large, inflexible, elaborate buildings which they cannot well afford to run. Hospital management is resorting to every possible expedient for reducing expenses. The budget of each department is being scrutinized searchingly. The mechanical plant is being appraised at its true market value—a sound investment or a frozen asset.

Engineering services play a major part in the hospital's economic structure. In round figures, 45% of the construction cost is spent in the shell of the building, 25% in the finish, and 30% for power, heat, plumbing, elevators, sterilizers, kitchen and laundry equipment, and electrical services. The cost at which it operates is the thing which counts today and always. The engineering budgets of 30 New York hospitals show a startling range from 3% to 9% of the total annual expense. A hospital superintendent, once a consulting engineer, made a study of the fuel, light, and power expenditures in 23 large New York City hospitals. The average cost was $106 per bed. His mechanical plant, $32.60. The high figure was $272. Nine hospitals above the mean average figure spent an excess of over $200,000. Making every allowance for variables in buildings, plants, and accounting procedures, there is

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These illustrations show plainly the point made by the author regarding excess radiation. Both views show a "standard" room located in the same state. The room to the left has at least twice the amount of radiator surface as the one to the right

evidence of too wide a gap in what hospitals are paying. A budget has been defined as a method of worrying before you spend instead of afterward, and many a hospital is regretting that it did not do more worrying during the planning stage.

Those of you who have enjoyed the extraordinarily interesting experience of working out the plans for a new building with a hospital group will appreciate the responsibility which devolves upon the architect, engineer, and consultant. It is no exaggeration to say that I have known committees to spend fewer minutes in the consideration of mechanical plans and specifications involving over $100,000 than they spent hours in selecting hardware and determining color schemes. It is the function of the architect, engineer, and consultant to weigh all suggestions, exert a restraining influence where needed, and in the end have the deciding voice as to the practical method of doing what is to be done.

Considering the complexity of the hospital problem, in my opinion the consulting engineer should be a constant in the hospital planning group, and present at all conferences where mechanical plans are being considered, rather than have the architect act as intermediary and interpreter.

There are certain fundamental principles which have been too often neglected in hospital planning—more study of dissatisfaction to enable us to correct and avoid previous mistakes, more alertness promptly to adopt new methods and devices, proven effective and economical, from within and without the hospital field, and a clearer understanding on the part of the architect and engineer of just what is to be accomplished, just what is needed, and how the hospital people will use it. It is my hope that an interpretation of some of these needs and the consideration of some past mistakes may result in avoiding in the future some of the quicksands in which so much hospital capital has been sunk. It is in the spirit of interpretation rather than criticism that my post mortem findings are set before you.

Heating

To illustrate the futility of planning without knowing, a hospital for which I was consultant about 15 years ago had a capacity of 115 beds. There were three buildings, to serve which two 100-hp. boilers were provided. One boiler has always been sufficient to carry the winter load. In a subsequent job of 120 beds, also with three buildings and approximately the same gross cubage and equipment, three 150-hp. boilers were specified. I questioned this, and after considerable opposition on the architect's part one boiler was omitted but the two that remained were held at 150 hp. The engineer whose name appeared on the power house plan some time later sought my influence with a client. I asked him on what basis he had made what seemed to me such an extravagant installation and learned that he had not designed the job but merely checked the boiler settings and connections.

From my experience the client's interest is not always best served and the savings not always real where the engineering fee is absorbed by the architect and the mechanical plant becomes largely a detail of the architectural design. The hospital should and can well afford to pay a full engineering fee in view of the large capital investment and the annual operating costs.

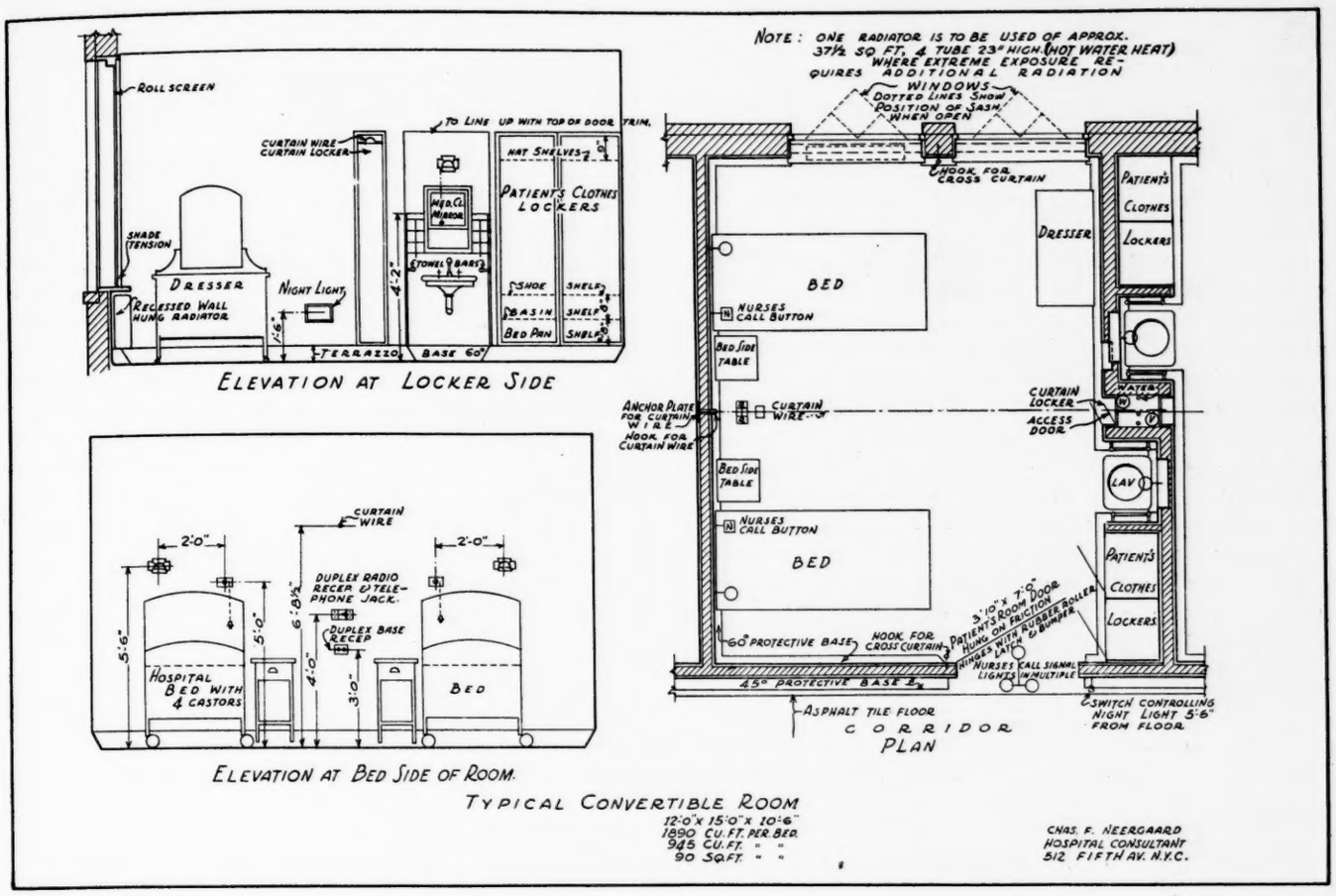
There are certain refinements that have been incorporated in heating systems with the best of intentions which, it would seem, might well be omitted. I never could see the justification for a thermostat in every room, although it is often done. In one hospital which has 94, the engineer recently reported that as they are marked "Cold," "Warm," and "Hot" instead of being calibrated in degrees; most of them are usually set on the hot side, resulting in room temperatures around 75°. There is no economy in that. Four of the lot were not working. Six were uselessly supplied in utility rooms where the sterilizers keep the temperature around 80° at which point they fail to function. If these thermostats had been omitted, the hospital would never have missed them. It would have saved $3,500 to say nothing of a considerable maintenance expense during the past five years.

Perhaps I am unorthodox, but I do not see the need of a radiator under every window. I first ventured to challenge this routine practice when I noticed that two radiators were shown on the plan in a little 8 ft. × 10 ft. room. Looking further through the building disclosed 48 more which seemed superfluous, incidentally meaning 96 valves and traps for some future engineer to keep in order. To be sure of my ground I consulted a friend, who made boilers and radiators. I told him that practical experience would indicate that if these 48 radiators were put in, many would never be used. "Would it be heresy to suggest cutting them out?" He replied with a question, "Wouldn't you think that the office of the vice-president of this company in its new building would be properly heated? Look about you." Under two of the five windows projected naked hangers from which radiators had been removed.

It is surprising how often the fact is lost sight of that kitchens, laundries, and sterilizing rooms need only enough radiation to avoid freezing.

The hospital needs adequate heat but no more. If common practice calls for 70° in zero weather, don't give us radiation for 80° at 10° below. Extra blankets are cheap and plenty, and in emergencies we can turn the electric fan on the radiator and speed up the circulation.

Ideas and practice seem to vary widely in designing heating plants. Two hospitals were built in the New York zone a few years ago, one on a hill overlooking the Hudson with nothing between it and the Alleghenys to stop the wind; the other in a valley surrounded by trees with no exposure. In both we used what I call the convertible room, designed to accommodate either one or two patients. The room is 12 ft. × 15 ft. with a 9½-ft. ceiling and has two windows with 48 sq. ft. of opening. In both jobs the same wall construction, the same metal windows and pressure hot water, by all odds the best heat for a hospital, were used. In the hospital with extreme exposure one engineer provided 48 sq. ft. of radiation with ¾-in. connections. In the other, a different firm specified 62 sq. ft. of radiation and 1¼-in. connections. While the plant was designed



Details of the "standard" convertible room designed by the author

as a pressure system and circulating pumps in duplicate were installed, it has been operated by gravity and the pumps have never been used. No control of the water temperature was provided for, so that the operating economy of a hot water job was lost. The smaller installation tested by four winters has proven ample. The larger we figured cost at least $6000 too much. I have often wondered whether the architect and building committee had any inkling of how badly they were stuck.

There is a third chapter to this story. One of my associates, a Canadian architect, has delved into a factor which seems too largely ignored in the States—thermal insulation. He designed a hospital in Canada with walls and roof thoroughly insulated and windows triple glazed, which enabled him to reduce the necessary radiation to 5100 sq. ft. against 11,000 sq. ft. which would be needed with ordinary construction. In the same convertible room with the same window area, he used but 30 sq. ft. of hot water radiation—in a section where 10° to 20° and even 30° below zero temperatures are frequent. He tells me that enough was saved on the heating plant to about pay for the insulation, so that the fuel savings through the years to come will be all velvet. To me these instances are significant —for the same room, 62 sq. ft., 48 sq. ft., and (with adequate insulation and tight windows) 30 sq. ft. of radiation.

This matter of insulation obviously has great possibilities. The reports on this hospital were so impressive that I took a week off to visit it and see with my own eyes what had been accomplished. The consulting engineers used a heat loss coefficient for both walls and roofs of 0.08 B.t.u. per sq. ft. per degree difference, as compared to about 0.3 B.t.u. for the ordinary wall and roof construction we use in the States. Sooner or later someone will devise a satisfactory type of insulated curtain wall for a fireproof building and revolutionize our heating investment.

During the depression surveys made with the view of finding ways to reduce operating costs have disclosed unsuspected leaks running into thousands of dollars. You will perhaps be interested in some boiler room ailments which one of my engineering associates has listed. These are variously due to essential faults in design, lack of proper supervision, and incompetent operation. We have found the following:

Many instances of dirty boilers with poor combustion and shocking waste of coal.

Plants with no reserve boiler so that those used cannot be readily inspected and cleaned during the heating season.

Electrically-driven pumps and compressors where plenty of steam was available.

Lack of adequate feed water heaters and filters to remove impurities, oil, and oxygen from the feed water.

Steam exhausted to the atmosphere while raw cold makeup water is fed into the boilers. In one hospital in particular the shells and tubes of two boilers only four years old had deteriorated to the danger point, where they should have served 20 years if the steam

wasted in leaks and exhaust had been used to pre-heat make-up water and the operating engineer properly supervised and obliged to keep them clean.

The clean heated water from the refrigerator condensers which can be returned into the boilers or the hot water supply is many times passed into the sewer. Some hospitals have been found wasting almost as much water as they used.

Many radiator traps have been found damaged by excessive pressure in the heating mains.

In a number of plants there was no engine room control of temperature in the various buildings. Frequently, the heating system was fed through a pressure reducing valve from the high-pressure steam line apparently on the theory that temperature can be controlled by varying steam pressure. As ½ lb. pressure is as a rule sufficient to supply heat in zero weather and is the minimum at which a vapor or steam system will operate, the building is usually overheated; time and again on mild days we have found radiators on, windows open, and the fireman stoking to heat all out of doors. Proper control in many cases would have saved at least 30% of the fuel used for heating.

Ventilation

But enough on heating—mechanical ventilation as frequently practiced seems to represent the most striking form of mechanical extravagance. A few years ago the secretary for charities of a Catholic diocese discussed with me a proposed new hospital. Among other things he asked what I thought about mechanical ventilation. "I don't," I replied, "any more than I have to. In a small hospital two fans perhaps, one for the kitchen and one for inside toilets and sink rooms. Why do you ask?" "Well," he said, "we opened a new chronic home two years ago. Every room was ventilated. The system cost us some $15,000 but we have never once used it."

If a hospital is properly located in a quiet neighborhood where the air is clean and fresh, in my humble opinion the patients' quarters need nothing better than natural ventilation through the windows, with cross ventilation provided through the corridor door.

A good many years ago before I deserted building construction for the hospital field, I spent several months visiting new hospitals in the East and Middle West. I was frankly appalled with the amount of money which had been sunk in equipment which had been used but a short time and then allowed to stand idle and rust away. I can recall at least a score of the old air washing plenum systems that must have cost in the aggregate half a million dollars, not one of which was in operation.

A prize example has to do with a pavilion added a few years ago to a large hospital in the Metropolitan New York area. The engineer who designed the original plant was retained for the new wing. He dug out his old plans and carried all of the new ducts to the fan room in the original building, where he figured there was space enough for additional units. The plan was approved by all concerned and went to the builder from whom I had the story. Meeting the engineer on the job one day he asked, "Where do you want me to put those fans?" It seems that the old ventilating system had been scrapped some years before, the fan room stripped of equipment and used for linen storage.

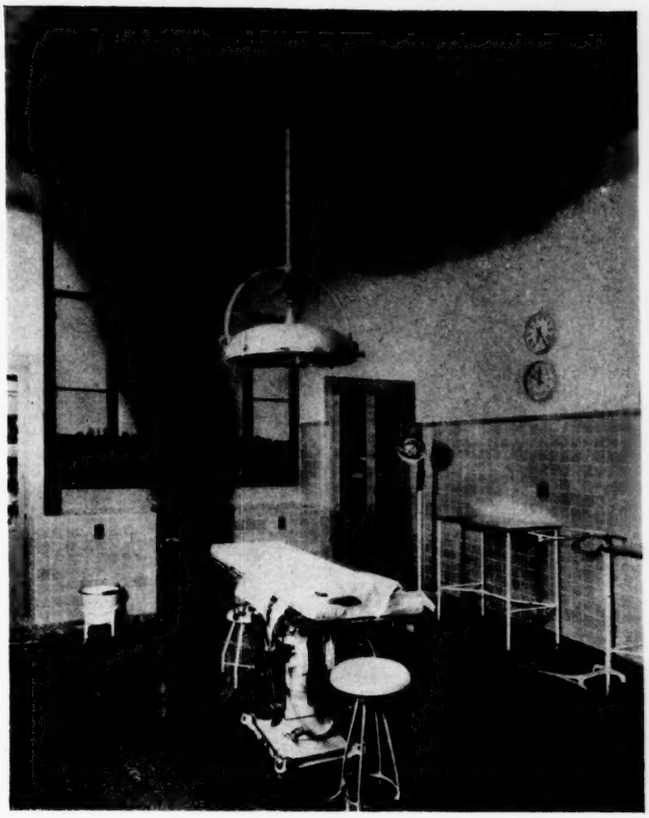
Another classic represents the persistence of the fixed idea. Preliminary to a new project the architect invited the building committee to inspect one of his previous jobs. It was a beautiful building in many respects but the ventilating plant I can only characterize from a layman's standpoint as the ultimate of absurdity. Every room, every toilet, every closet and, mark this, even every clothes locker, had its own vent duct, each of which was carried separately through to the fourth floor attic. This space was, as can be imagined, a forest of galvanized iron—little ducts, medium ducts, big ducts, siamesed together into a huge central chamber. It was solely a gravity system. We asked the president who showed us around how it worked and what he thought of it. "It doesn't work when we most need it, and if I had known when we were building what I know today, we should have saved $40,000."

The building committee went into executive session and suggested to the architect that all they required was the minimum of ventilation in its simplest form and specified what was to be covered. When the finished plans were presented imagine the amazement again to find individual ducts from every unit where ventilation was called for, 212 of them, carried side by side like the pipes of an organ up to the seventh floor attic where eight large fans were scattered. The system was designed with automatic dampers on each and every duct so that either fan or gravity could be used. Recommendations were made to eliminate the equivalent of over 8000 lin. ft. of ducts.

A number of years ago an engineer familiar with school work suggested using a unit ventilator in the operating room instead of a direct indirect radiator under the big window enclosed by a glass screen, according to common practice. By omitting the screen there was no extra cost in the substitution. The unit was quiet, simple, and satisfactory, giving 10 air changes an hour of filtered heated air; there were no drafts; ether fumes and odors were quickly dissipated, and the surgeons and nurses enthusiastic. We had chanced to select what has since proved to be the best make for hospital purposes. In subsequent jobs several other makes were substituted under the "or equal" clause. Complaints began to be heard and one of my engineer associates and I made a tour of six hospitals where we inspected 24 units of three different makes. We found but six functioning properly. They were all too complicated. There were three speeds on the motors, fresh air, recirculating, and mixing dampers, some automatic, some manually controlled. There were so many possible combinations that it was surprising any of the units worked at all. In no place did we find instructions as to how the equipment should be operated or serviced and in one building which had been open for six months, the engineer had never cleaned the filters.

The unit ventilator is highly effective in many places in a hospital. Units in operating and delivery rooms

should have no provision for recirculation, as it is dangerous to pass ether-filled air around most motors. Fresh air should be drawn from the outside and the temperature controlled by a mixing damper. There should be a single speed motor of sufficient capacity to deliver 10 changes of air per hour at low speed without noise. The mixing damper may be operated by hand, but the additional expense of some $50 for thermostatic control is well warranted. Experience has proved the pneumatic system which operates with a range of 2°, to be the most dependable. A supplementary radiator is used which will hold the temperature around 65°, and a simple type of spray humidifier provided.



A smoke bomb test of a unit ventilator in a hospital operating room

The operating room nurse has too much on her mind before and during an operation to give thought to things mechanical. If the unit is designed as suggested, all that she has to do is to throw the switch and keep the room door closed so that the air may exhaust up the gravity duct.

In nurseries and labor rooms a recirculating unit is used with a damper which mixes room air with outdoor air in proper proportions to maintain the desired temperature. No supplementary radiation is required. In these rooms which are constant sources of disturbing screams and cries, it has been customary to install soundproof partitions and acoustical treatment, but when the windows are open, the cries pass out and back into the windows of patients' rooms near by. With the unit the windows may be kept closed.

In all of the rooms above mentioned the unit should be connected with the reduced high-pressure steam lines so that heat may be had in the spring and fall when the heating system is not in operation.

Air Conditioning

The world is informed by many and sundry advertisements that air conditioning is ready and waiting for all who have the price. To the average layman air conditioning means primarily a cool room on a hot day. He senses perhaps that he is more comfortable in dry air when the thermometer stands at 80° than he is in wet air at 75°, but relative humidity, air filtration. air movement, and changes per hour are scientific trimmings which he is ready to take the engineer's word for.

I received a letter recently from a professor of medicine decrying the high cost of hospitals. In closing he said, "Unquestionably no hospital in the future should be planned without complete air conditioning." I wonder. At the present stage of the art hospitals can not afford it. No hospital, so far as I know, has tried it. In an office building completed three years ago, equivalent in cube to a 300-bed hospital, the cost of installing the heating plant was $68,000, the air conditioning equipment $165,000. In the first year they spent, aside from labor, $6100 to heat the building and $17,000 to operate the air conditioning plant. An office building is used 8 hr. a day, 6 days a week; a hospital is used 24 hr. a day, every day in the year. If a hospital the size of this building had been similarly equipped, the operating cost for heating and air conditioning would have been double. However, the introduction of air conditioning throughout a hospital would not involve an additional expense of three times the cost of heating as the hospital is already spending a considerable sum for mechanical ventilation which would be absorbed in the air conditioning. Furthermore, the heating expense would be greater without air conditioning because windows would be opened and much outside air heated instead of inside air recirculated. Completely to air condition a hospital involves so large a capital investment and such a major increase in the operating budget that the innovation should be approached with extreme conservatism.

In certain special units — operating and delivery rooms, constant temperature and premature rooms— air conditioning is not only desirable but will soon become an essential. However, lacking the findings of research, stated requirements are often contradictory, and approved standards few. Surgeons in 10 hospitals questioned as to ideal operating room conditions advocated temperatures ranging from 70° for thyroid work to 82° for general surgery. Some desire a relative humidity of between 55% and 60%, others 45% to 50%. A committee of the A.M.A. has determined that a relative humidity of 55% spells safety from gas explosions due to static electricity. In the John B. Pierce Laboratory of Hygiene, recently opened at the Yale University Medical School, intensive studies which should be illuminating are to be made of all aspects of the subject.

It is not surprising that the engineering fraternity is somewhat baffled to determine what the hospital should have, and to be on the safe side oftimes aims at a degree

of perfection which is perhaps more ideal than practical. I quote from a recent article in an engineering magazine, describing the air conditioning of an operating suite. Two surgeons operating in adjoining rooms required respectively 76° and 78° temperatures. Both concurred in 60% relative humidity. The author states, "Temperatures are maintained within ½° and with some changes now in progress it is hoped to maintain relative humidity within less than ½ of 1%." Can such precision be justified by any sound physiological premises? Are any of us sufficiently sensitive to detect a variation of 3° and 4° between 70° and 80°? The most accurate commercial thermostat is permitted a range of 1° above and below. Can any surgeon, nurse, or anaesthetized patient note a smaller variation, or can the most explosive gas used in surgery react to ½ of 1% fluctuation in humidity? Precision costs money. How much is that hospital paying for perfection? I do not know but my suspicions are that it comes high.

In the present stage of the science, particularly in view of the expense involved, the most practical equipment for the patients' quarters would seem to be some form of portable unit which can be wheeled into the room of the patient needing it, as is done with the portable X-Ray or ultra violet lamp. In special departments where the therapeutic value of the air conditioning has been conclusively demonstrated, the trustees will find money for its installation.

The modern monolithic building is excessively noisy and the patient is vividly aware of every sound. Perhaps nothing can contribute so much to the patient's comfort as quiet.

Should we not incorporate in hospital specifications at least, one of these comprehensive clauses under which a mechanical plant that is noisy will not be accepted any more than one which leaks.

Operating the Plant

To size up the operating engineer's responsibilities, I once inventoried the number of things he had to operate, adjust, repair and replace in a 100-bed hospital where the mechanical plant cost $195,000. There were 569 pieces of fixed equipment, including radiators, plumbing fixtures, refrigerators, sterilizers, motors and machines, controlled by a total of 1728 valves, traps, switches and faucets. How many miles of piping and conduit there were I did not attempt to determine.

Have pity on the operating engineer! To a reiterated plea for simplicity let me add four more on behalf of the many individuals who during its life must learn the anatomy of your plant and keep it running. Standardize valves and faucets so far as practical and require all of the different equipment people to use one make, so the engineer will have less parts to carry.

Identify all pipes by the accepted color chart and make the engineer's search for trouble an easier one.

Above all furnish him with a corrected set of plans. We all know that because of conditions on the job the plumber and steamfitter frequently have to run their pipes otherwise than where the plan designates. We know it, but some years later when a leak develops, the engineer doesn't. He gets out the drawings, presumably locates the offending member and cuts through the wall or floor only to find that the pipe is not there. If you leave behind your plans which show where the pipes really are, the hospital's favorite indoor sport—mining for leaks—will lose much of its thrill.

My fourth suggestion may savor of childish things, but its value is very real. Make a scrapbook, in fact, make three identical scrapbooks, one for the hospital superintendent, his successors or assigns, one for the operating engineer, his successors or assigns, and one, a reserve copy, for your own office in case the others are lost. In these scrapbooks assemble and index the manufacturer's charts and instructions for the adjustment, operation and upkeep of each piece of equipment in the building. Usually this information comes to the job attached to the machines. Many times it is thrown away with the wrappings; few copies ever reach the person who should have them. While manufacturers follow up and service their jobs, the verbal instructions given are of little permanent value because of labor turnover.

In building a hospital we are always confronted with a limited appropriation and it takes a keen sense of relative values to spend it to the best advantage for permanent results. If the architect puts 100,000 superfluous cubic feet in his building, it may be necessary to omit 10,000 ft. of acoustical treatment, its cost equivalent. If the engineer, through an excess of caution, provides a non-essential boiler, the X-ray Department may be deprived of its deep therapy apparatus. The savings on unnecessary radiators will perhaps pay for the diathermy and electro-cardiograph equipment. I would gladly at any time exchange 8000 ft. of futile galvanized iron ducts for the equivalent in furniture steel doors, which never require adjustment, and barring accidents, no refinishing in 20 years. The $6500 saved from a useless vacuum dust mop cleaner will enable the hospital to substitute metal cabinets for wood, and to use monel metal or stainless steel for counter and table tops instead of galvanized iron. The omission of 94 individual thermostats would pay for micro-drive on two elevators and prevent the bumping of food carts and stretchers on and off the car for generations to come. Over-emphasis on any feature of construction or equipment which imposes overdrafts on the building fund is invariably disastrous. The hospital should be mechanically endowed with everything it needs. There is usually enough money to do this and do it well, if the non-essentials are cut out.

Let no one interpret anything I have said as disparaging the architectural or engineering professions whose genius and skill have brought the hospital structure to its present state of excellence. I am reporting on Hospital Pathology, the ailments and handicaps that have made hospitals financially ill—with a view to their cure and future prevention. If with further progress we can combine the avoidance of past mistakes, we shall soon have the perfect hospital.

Let me close with a plea for more considered planning in the hospital mechanical plant, for more insistence that every mechanical feature be justified, and for the superlative value that lies in simplicity.

Annual Summary and Review—1933

THE year 1933 was so greatly different from its immediate predecessors that it stands out in sharp relief. It saw general business sink to lower depths than any reached in the three preceding years, saw the banks all spectacularly closed, and then witnessed a sharp upturn in volume in the later months. Behind all this is the story of how ideas and practices which were thought to have no chance a year ago are now being tried out. Fair practice and licensing were merely ideas a year ago. Now fair practices have at least been codified and clarified, while actual licensing has been undertaken in a few industries.

Eventful as the year was, the volume of building construction, maintenance, and modernization fell off. New building during the year was about 20% less than in 1932, and activity in heating as indicated in index numbers also fell about 20%. The sharp upturn in the rate of activity of general business following the March collapse was reflected in heating when the activity rose from a low of 27 to a high of 45 in July. Activity at the year-end when corrected for seasonal variations is approximately at the levels of a year ago.

During the year, too, certain lines of activity within our industry were much more interesting than others. In this issue for the first time a number of curves and index numbers are published which give an adjusted view of the month-by-month changes in a number of equipment groups. The curves are well worth study, for they can be used to act as straws to indicate in which way the wind is blowing. Particular attention is called to the sharp upswing in the curves of small stoker sales which have taken place in the past few months. This movement toward stoker-firing has been in the offing for some time. Careful attention to the other curves will show in several cases equally interesting and meaningful shifts.

Codes and Trade Associations

From the viewpoint of volume of work done, the NRA code activities have been of outstanding importance since the enactment of the law in June. They have absorbed the time and effort of countless people, in many cases almost to the exclusion of all other activities. They vitally affect every person engaged in the industry or any of its parts. Most of them are now complete, and the year-end finds several in operation, others ready for approval, and several receiving their public hearings almost on New Year's day. Proposals for master codes to unify and coordinate the manufacturing and the installation and engineering activities of the industry are pending at the year-end. The year saw all these ideas develop to a working stage. It did not provide any basis on which to judge their success in practice.

The work of the trade and professional groups in developing them is summarized on following pages, as are other important works of the trade associations during the year. These organized groups enter the new year bearing greatly increased responsibilities over those they carried a year ago.

Interesting Installations

Even with the small building volume of 1933 there were several installations of heating, ventilating, or air conditioning equipment which are notable. Acceptance of air conditioning in the government building program continued to gain ground. The Department of Justice and Archives Buildings at Washington are notable examples of its inclusion. Rockefeller Center in New York continued active throughout the year and added to its record in the use of air conditioning in commercial buildings. The beautiful new Art Museum at Kansas City installed a modern plant and serves as an example of late practice in buildings of this character. The usefulness of central heating in groups of buildings caused the Washington government to erect a beautiful plant to supply the newly erected government buildings.

Research

Research work has come to be such an important part of our interests that a summary of what has taken place is included on the following pages. Due to financial problems the volume of this work was greatly lessened during the year. Even so, the list of active projects is still impressive. For the first time we include a list of projects at the colleges and universities. Replies to recent inquiries prompts the conclusion that those listed are either still active at the year-end or that they were actively pursued and completed during the year. So far as possible, dormant, abandoned, or proposed projects are not in the list.

New Equipment

Ideas find their way into new equipment and become of direct commercial importance to all of us. In order to help keep abreast of these announcements and to furnish a summary of them, considerable space is given to what happened in New Equipment in 1933. The analysis shows several interesting trends.

Prospects

We enter the new year with tangible prospects of better business than during 1933. The bank and mortgage situation is being straightened out. It should be well along before 1934 is far advanced. Prospective demands have accumulated; contemplated work has shown a most astonishing increase in the past 90 days. Federal funds allotted to building should be spent in the next few months. Practically all the indexes are moving upward at the year-end. Retail trade reports lead to the belief that money is actually being spent again. The NRA codes should soon be in operation. There is reason for getting really optimistic about 1934.

Business Gains in Closing Months a Feature of Statistical Summary†

EVEN in periods of business stress this industry can point to some notable accomplishments, such as have been outlined elsewhere in this review of 1933. When it comes to the statistical summary of the year's activity, however, we are facing cold figures which reflect only measurable results, just as our bank statement shows our income and expenditures—with no explanations, no alibis and (frequently) with little comfort.

A few bright spots stand out even in the statistical records of 1933. Moreover, the outlook for 1934 is more cheerful, so that we can glance back at the results of our year's work without feeling too keenly our failure to set new records.

This is being written in late December. Figures for most branches of the business are not available later than October, so that the comparisons which follow are all based on the first 10 or 11 months as compared with the corresponding period in the previous year. In making such a comparison we are assuming, therefore, that the remaining months will show the same average gain or loss that the preceding months did. This is not necessarily true. The closing months of 1933 *may* improve the comparison.

If every business man in the country were required to report month by month the volume of business he did it is obvious that accurate measures could be made of business trends. It is equally obvious that such data are not available, and that no such gauging of trends by these means is possible. In most businesses, however, activity can be followed indirectly, and in our business the relative volume of work being done is reflected in the quantities of materials sold. These volumes indicate what the manufacturer is doing, how busy the wholesaler is, and equally as well tell us how things are going in the installing end of the industry.

For these reasons, the volume of business done by makers of the different equipments is worth some study. When following these records of shipments, or sales, or orders, we should keep in mind that every radiator, for instance, sold, makes employment for not only the foundrymen, but the sales force, clerical help, and executives; it means work for railroads, trucks, steamfitters and contractors, and for engineers. Every blower sold has or will give employment to metal workers, sheet metal men, engineers, salesmen, and many others. The records which follow, then, mean more than merely a dry compilation of figures. They tell a story of employment (and unemployment), and profits (and losses). They tell us fairly definitely the relative prosperity of the different groups in the industry.

In studying the record, we will briefly pass over what has happened to business in general, dwell at somewhat more length on building, with which heating and ventilating business is so closely related; and then take up in some detail the various component branches which make up the heating, ventilating, and air conditioning industry.

†Acknowledgment is made of the cooperation of the following who assisted in supplying data on which the material in the article is based: Department of Commerce; Bureau of Labor Statistics; F. W. Herendeen, secretary of the Institute of Boiler and Radiator Manufacturers and of the Gas Heating Boiler and Furnace Association; Allen W. Williams, secretary of the National Warm Air Heating and Air Conditioning Association; E. A. Goldenweiser, Director of Research and Statistics, Federal Reserve Board; the editorial staffs of "Engineering News-Record," and "The New York Times"; C. George Segeler of the American Gas Association, and the F. W. Dodge Corporation.

General Business

Three major periods are to be noted as having an effect on business during the year. The bank closing in the spring, which reduced many industries to new lows for the depression; the revival of confidence on the part of the public, a period which lasted until late summer; a new decline in business which extended into the closing months of the year—these are the main periods of 1933, and they are clearly shown in Fig. 1.

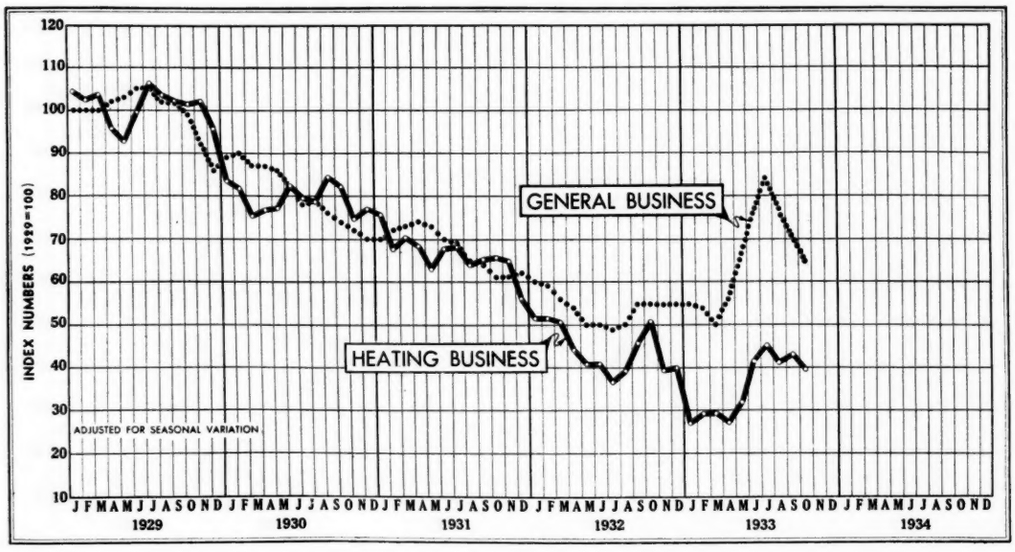

INDEX NUMBERS (1929=100)
120
110
100
90
80
70
60
50
40
30
20
10
GENERAL BUSINESS
HEATING BUSINESS
ADJUSTED FOR SEASONAL VARIATION
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1929
1930
1931
1932
1933
1934

Fig. 1. A comparison of business in general with business in the heating industry. The former is based on the Federal Reserve Board Index of Industrial Production, adjusted for seasonal variation, recomputed to 1929 equals 100.

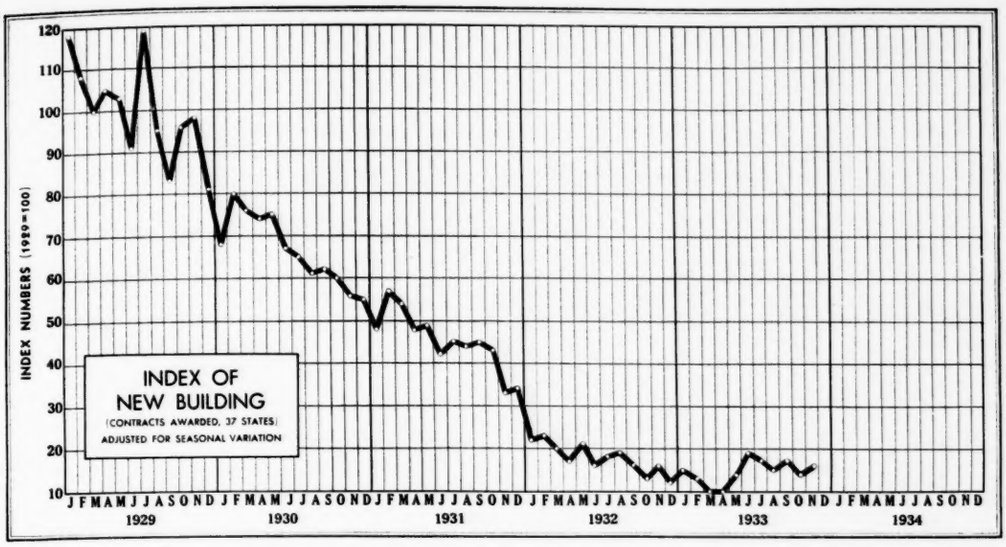


Fig. 2. A record of new building of all kinds, based on building contracts awarded in 37 states as reported by F. W. Dodge Corporation, and adjusted for seasonal variation. Note that this graph covers building only and not other types of construction.

The following tabulation[1] of two well known indices of business—carloadings and steel mill activity—shows that in the early months 1933 lagged behind 1932, summer months jumped way ahead of 1932, and the closing period showed only a fair gain over 1932.

	Carloadings		Steel Mill Activity	
	(Per cent of estimated normal, adjusted for season)			
	1932	1933	1932	1933
First week in February..	65	55	37	26
First week in July.....	50	65	23	78
First week in December.	58	59	27	45

Building

Particularly in recent months, newspaper reports indicate sharp gains in construction, which, although encouraging, do not directly affect those of us concerned with heating and ventilating. It is true that construction shows some gains over 1932, but these gains were in types of construction other than building. As a matter of fact there was a decline of 20% in building contracts for 1933 as compared with 1932, according to Dodge reports covering 37 states. The total for the first 11 months of 1933 for these states was $579 million as compared with $723 million in the corresponding period of 1932. The progress of building is shown in Fig. 2.

Several important points stand out sharply in the detailed analysis of the building records. These may be summarized as follows: (1) A 60% to 70% decline in educational and public buildings; (2) a really startling increase in industrial building, which showed a gain of 201% in 1933 over 1932; (3) a pronounced increase in the building of dormitories, a rise of 142%; (4) a relatively small decline in the building of one and two-family houses, the dollar volume of which fell only 17%.

An examination of the figures covering all of the different types of building shows that 1933 will close with a drop in volume of about 22% in non-residential building. That this is not more severe than it is is due to the gain in industrial building, all other classes having fallen off. A disappointing feature of the year was the severe drop in public building which, although appropriations had been made, failed to reach the contract stage in time to register a sufficient amount to gain over 1932. Residential building as a class dropped

[1]Computed by *The New York Times* from data supplied by the American Railway Association and Dow, Jones & Company.

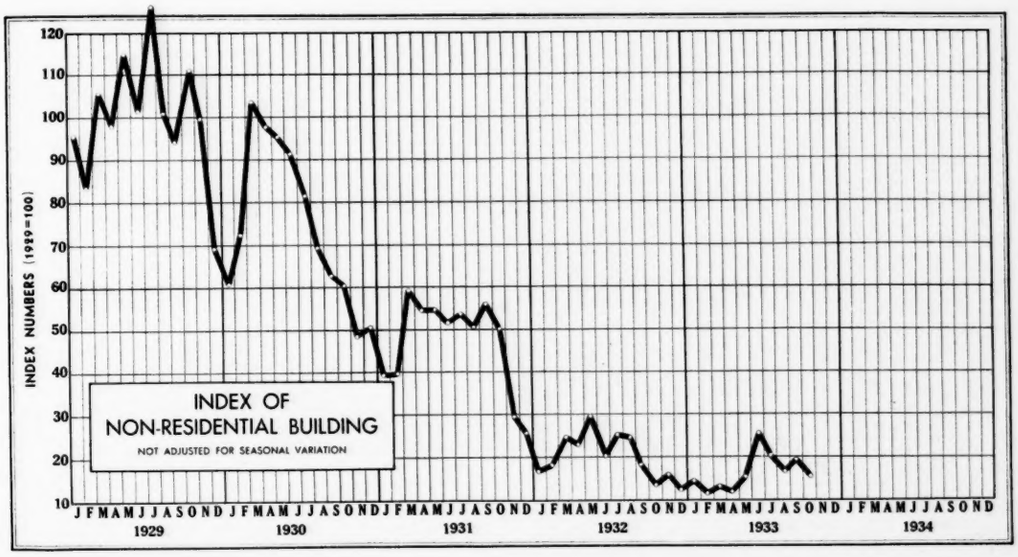


Fig. 3. New non-residential building based on building contracts awarded, and including all types of building not used for housing purposes.

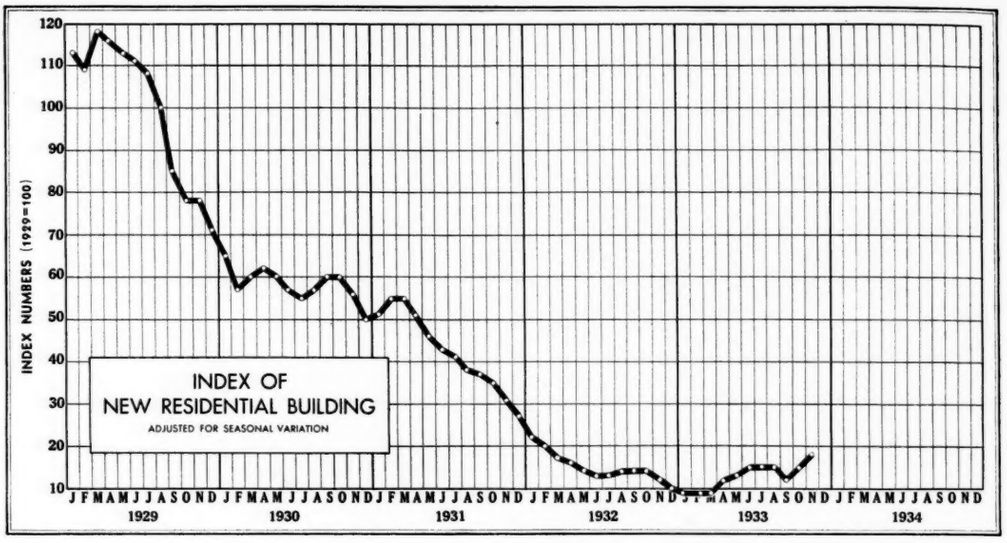


Fig. 4. New residential building based on building contracts awarded, and including apartments, dormitories, hotels, one- and two-family houses and large scale housing projects.

from $267 million to $225 million, a decline of nearly 16%.

Curves showing trends in both residential and non-residential building appear in Figs. 3 and 4.

COMPARISON OF BUILDING IN 1933 WITH 1932
(DOLLAR VOLUME, CONTRACTS AWARDED, BASED ON F. W. DODGE CORPORATION DATA FOR 11 MONTHS)

Commercial	— 21.1%
Industrial	+ 201.0
Educational	— 68.8
Hospitals and Institutions	— 27.6
Public	— 63.0
Religious and Memorial	— 36 2
Social and Recreational	— 32.2
Total Non-Residential	— 22.4%
Apartments	— 26.6%
Dormitories	+ 142.3
Hotels	— 37.2
Houses	— 17.4
Housing	— 40.0
Total Residential	— 15.6%
Grand Total	— 19.9%

A loss in volume was reported in every region covered by the 37 states, with two exceptions: The southeastern and Texas. The former showed a very small increase in residential building, but building in the Texas region rose 46%, the gains being in both residential and non-residential buildings.

Aside from building contracts awarded, however, the closing months of 1933 show an astonishing increase in the volume of business being *planned*. Figures reported by Dodge on "contemplated projects" reveal an increase in almost every type of building, the gains being most marked in educational building, hospitals and institutions, and public buildings. Three times as much in residential building was reported in November, 1933 as in the same month in 1932, while this ratio was 16 to 1 in educational buildings and 28 to 1 in public buildings.

Heating

Fig. 5. shows graphically the trend of the heating business[2] during the last few years. Business in the second half of 1933 nearly reached 1932 average, but the slump experienced in the opening months made it impossible for 1933 to show an improvement over the

[2]Note that the Index of Heating Business is corrected for seasonal variation. The Index combines the activity of business in radiators, cast-iron square and round boilers, oil burners, and gas boilers. Sales of these equipments are considered to be a reliable indication of activity in the whole heating industry. For details concerning construction of this index see HEATING AND VENTILATING, November, 1933, page 7.

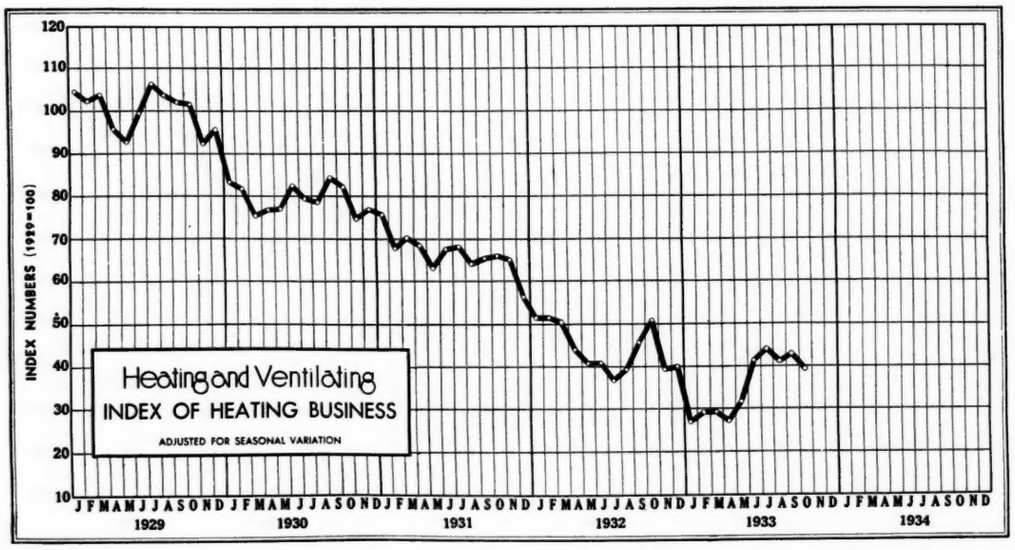


Fig. 5. HEATING AND VENTILATING's Index of Heating Business Activity as adjusted for seasonal variation. The index for recent months was: August, 41.2; September, 43.0; October, 39.6.

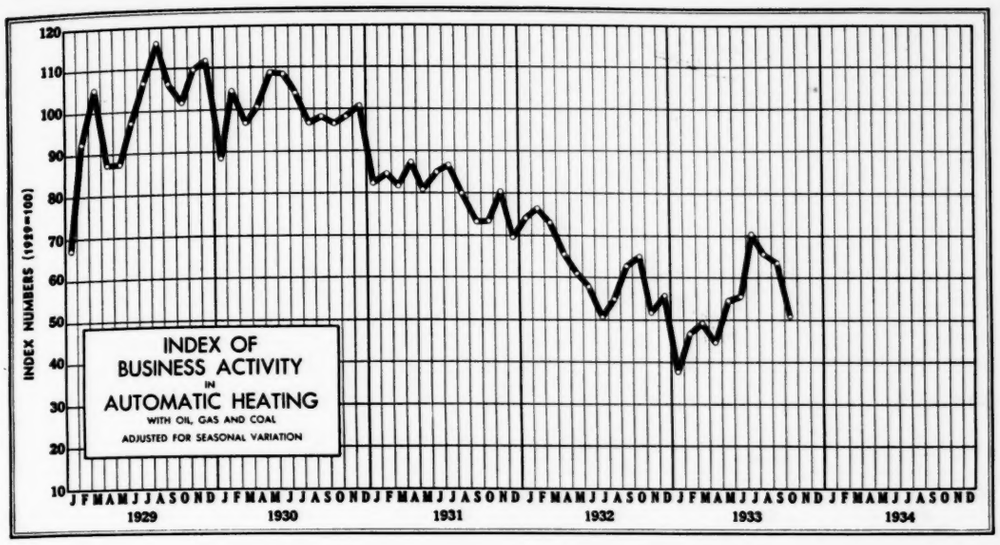

INDEX OF
BUSINESS ACTIVITY
IN
AUTOMATIC HEATING
WITH OIL, GAS AND COAL
ADJUSTED FOR SEASONAL VARIATION
INDEX NUMBERS (1929=100)
120
110
100
90
80
70
60
50
40
30
20
10
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1929
1930
1931
1932
1933
1934

Fig. 6. HEATING AND VENTILATING's index of the progress of business in automatic heating, based on sales of oil burners, small and medium sized stokers and gas boilers.

preceding year. Consequently, the heating industry showed approximately a 20% decline from 1932, a drop which corresponds to the drop in new building.

Automatic Heating: Progress in heating with automatically-fired fuel-burning devices can no longer be measured by the trend in the oil burner business alone. Consequently, the "Index of Business Activity in Automatic Heating with Oil, Gas and Coal" has been prepared by HEATING AND VENTILATING and presented in Fig. 6.[3]

This index shows that automatic heating dropped off rapidly in the closing months of 1933. As a matter of fact, the only reason this combined business held up as well as it did was due to the remarkable showing made in stokers, a point which will be discussed more at length later. On the whole, automatic heating showed a decline in 1933 of about 15%, as compared with 1932, a better record than that made by the heating industry as a whole.

Oil Burners: Installations of oil burners showed a drop of 14% from 1932, the greater percentage drop being in natural draft burners, which fell off 40%, while mechanical draft type declined only 7%. A disappointing feature of the oil burner business in 1933 was its failure to reach the usual seasonal peak in October, see Fig. 7. October sales dropped from those in September in 1933 for the first time since production figures are available.

Stokers: One of the few branches of the industry to make a favorable showing in 1933 was the stoker business. Class 1, 2 and 3 stokers[4] increased (in number of units installed) 35%; the Class 1 type actually showed a gain of 39%, Class 2 a loss of 11%, and Class 3 the rather startling increase of 60%. The total number of installations of residential type stokers made during 1933 was in the neighborhood of 8500—a truly remarkable accomplishment.

Gas Heating: In view of the high fuel rates relative to oil and coal, gas heating equipment sales were better than could have been expected; in fact, much better than would have been predicted. Gas boilers were off only 8% from 1932, 3146 units having been sold up to October 1.

[3]This index has not appeared before. It is based on sales of domestic oil burners (U. S. only); gas boilers, and Class 1, 2 and 3 stokers. Power stokers are not included. Further information regarding this index is available on request.

[4]Class 1 stokers burn less than 100 lb. of coal per hr.; Class 2, 100 lb. to 200 lb.; Class 3 are large commercial types. Class 4, power boiler and industrial stokers are not included in this summary.

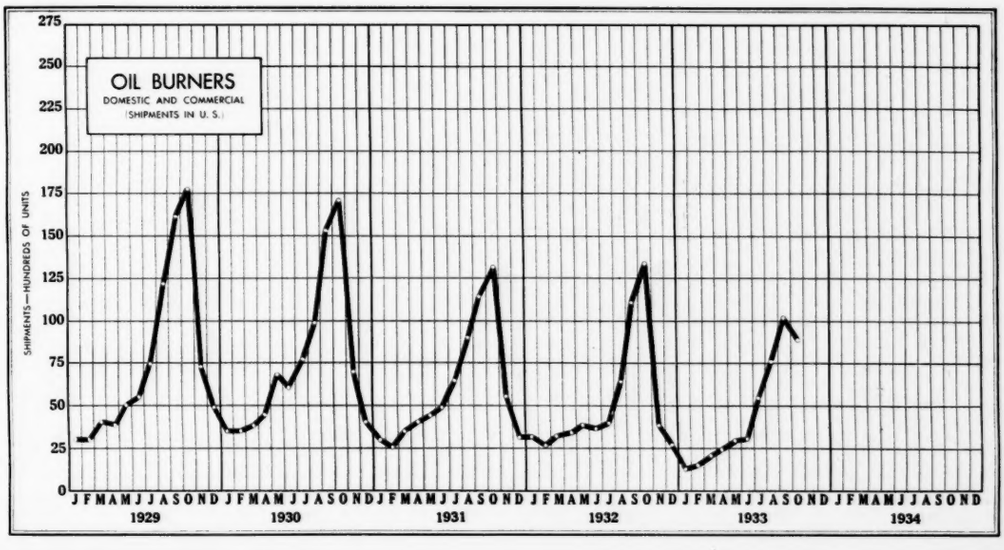

OIL BURNERS
DOMESTIC AND COMMERCIAL
(SHIPMENTS IN U. S.)
SHIPMENTS—HUNDREDS OF UNITS
275
250
225
200
175
150
125
100
75
50
25
0
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1929
1930
1931
1932
1933
1934

Fig. 7. This graph showing oil burner shipments does not include domestic burners shipped abroad.

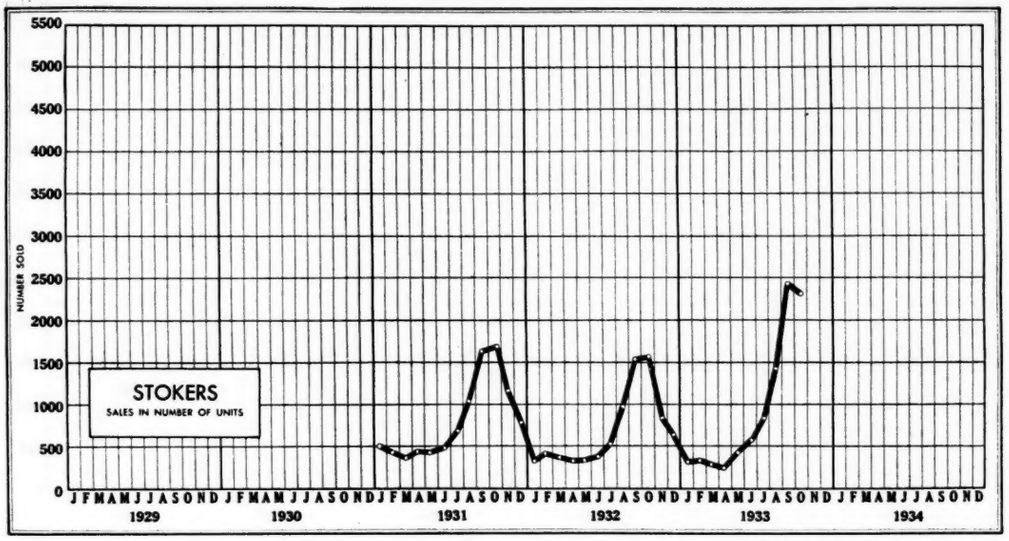

STOKERS
SALES IN NUMBER OF UNITS
NUMBER SOLD
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1929
1930
1931
1932
1933
1934

Fig. 8. One of the outstanding accomplishments of the year was the record made by the stoker industry, shown here graphically.

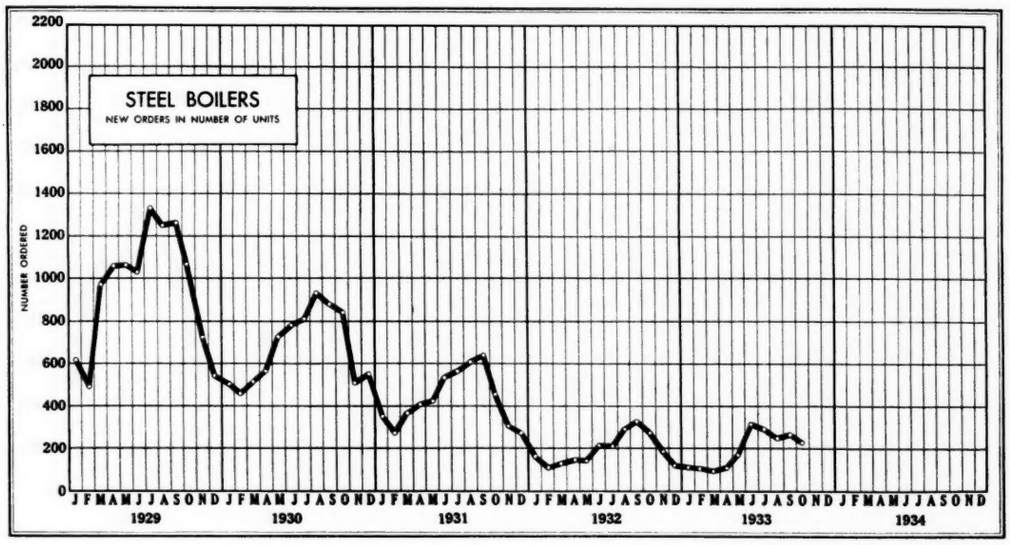

STEEL BOILERS
NEW ORDERS IN NUMBER OF UNITS
NUMBER ORDERED
2200
2000
1800
1600
1400
1200
1000
800
600
400
200
0
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1929
1930
1931
1932
1933
1934

Fig. 9. New orders for steel heating boilers. This business suffered during 1933 from the lack of new large buildings.

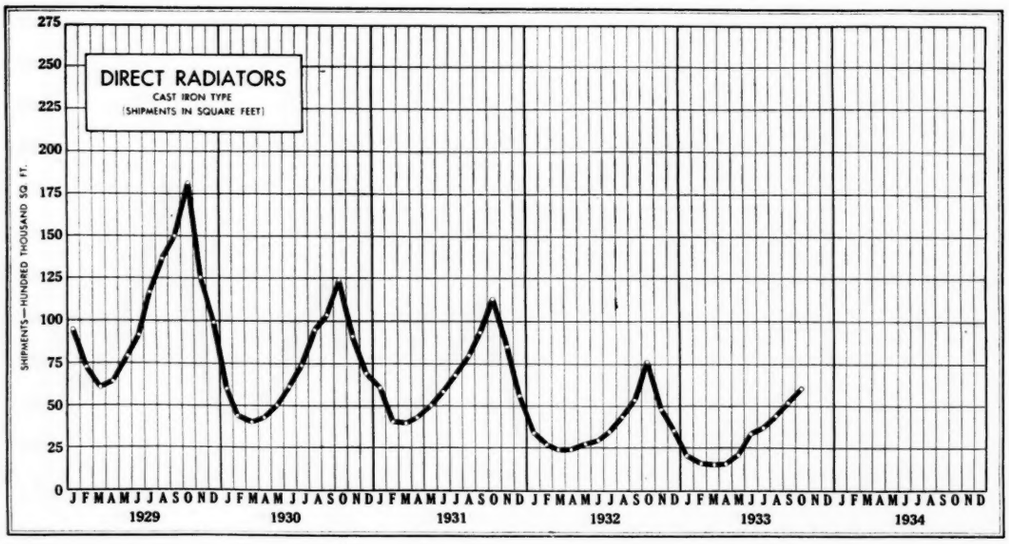

DIRECT RADIATORS
CAST IRON TYPE
(SHIPMENTS IN SQUARE FEET)
SHIPMENTS—HUNDRED THOUSAND SQ. FT.
275
250
225
200
175
150
125
100
75
50
25
0
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1929
1930
1931
1932
1933
1934

Fig. 10. This chart shows the shipments of direct cast-iron radiators of all types.

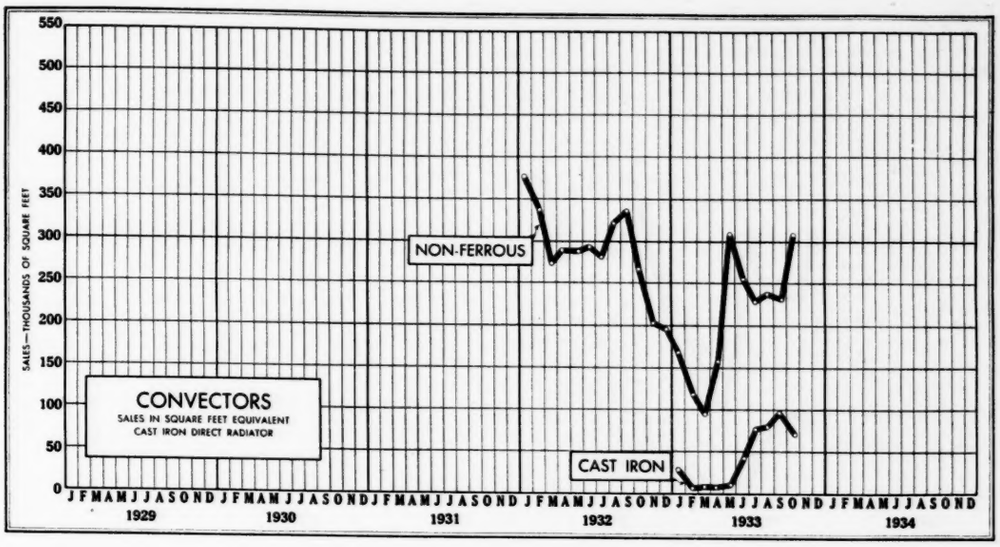

SALES—THOUSANDS OF SQUARE FEET
550
500
450
400
350
300
250
200
150
100
50
0
NON-FERROUS
CONVECTORS
SALES IN SQUARE FEET EQUIVALENT
CAST IRON DIRECT RADIATOR
CAST IRON
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1929
1930
1931
1932
1933
1934

Fig. 11. Concealed radiators, made up of both nonferrous and cast-iron type, are shown in this graph. The data include both elements sold separately and elements sold in connection with the cabinets, enclosures, and grilles.

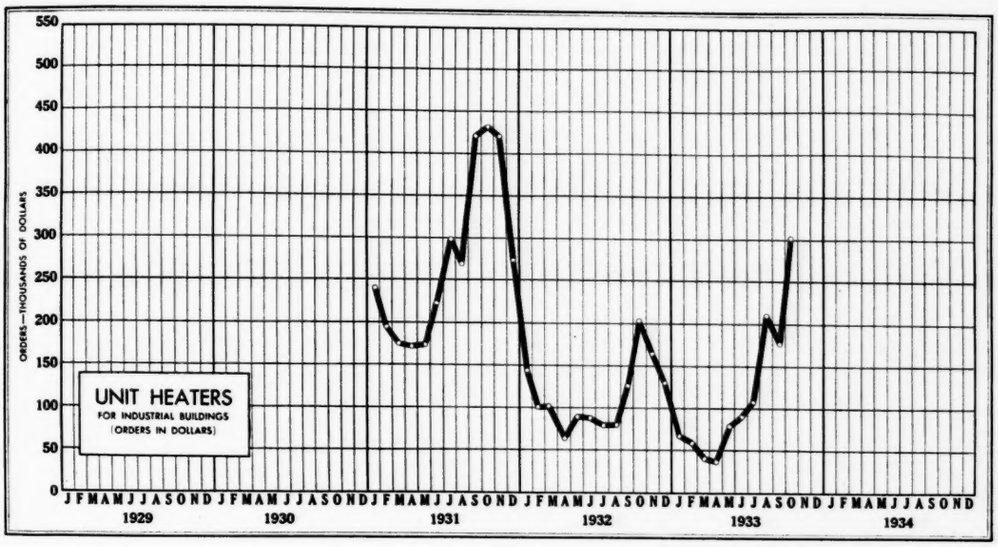

ORDERS—THOUSANDS OF DOLLARS
550
500
450
400
350
300
250
200
150
100
50
0
UNIT HEATERS
FOR INDUSTRIAL BUILDINGS
(ORDERS IN DOLLARS)
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1929
1930
1931
1932
1933
1934

Fig. 12. The stimulation of industrial building during 1933 resulted in increased activity in the sale of unit heaters.

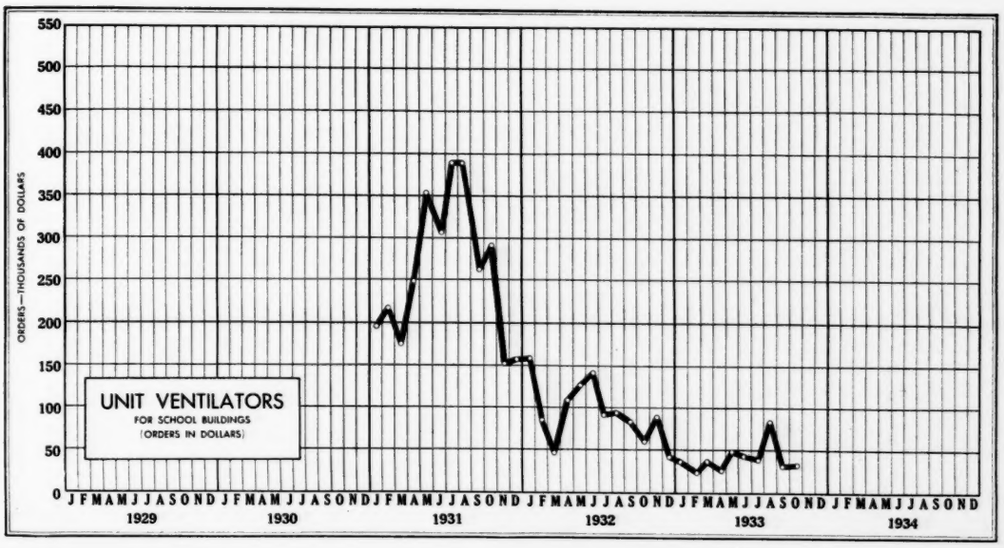

ORDERS—THOUSANDS OF DOLLARS
550
500
450
400
350
300
250
200
150
100
50
0
UNIT VENTILATORS
FOR SCHOOL BUILDINGS
(ORDERS IN DOLLARS)
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1929
1930
1931
1932
1933
1934

Fig. 13. Unit ventilators, which find their greatest market in school buildings, have suffered from the almost complete lack of new school building during 1933.

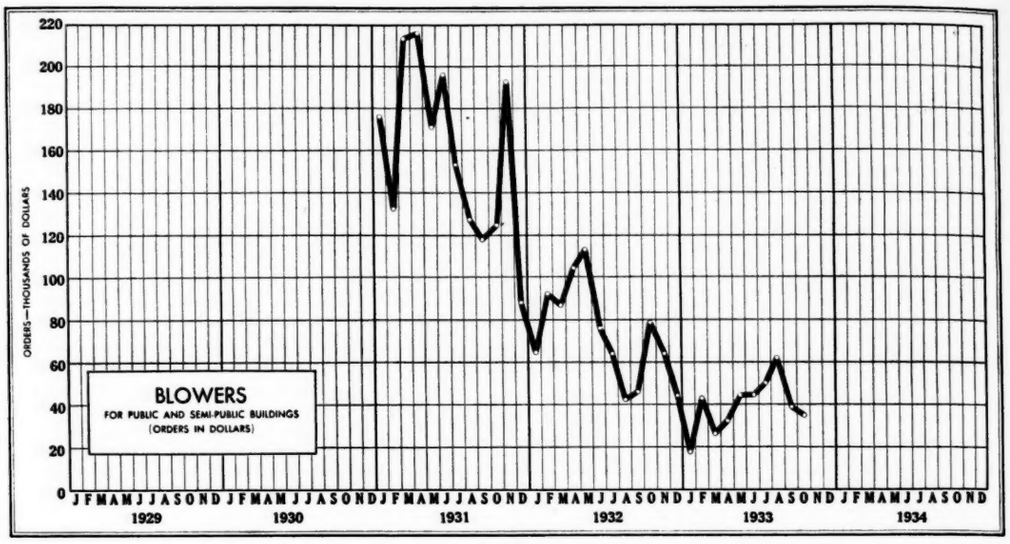

ORDERS—THOUSANDS OF DOLLARS
220
200
180
160
140
120
100
80
60
40
20
0
BLOWERS
FOR PUBLIC AND SEMI-PUBLIC BUILDINGS
(ORDERS IN DOLLARS)
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1929
1930
1931
1932
1933
1934

Fig. 14. This chart shows graphically the sale of blowers as used for ventilating public and semi-public buildings.

No data are available on gas conversion burners for the two years, but the aggressive campaigns put on by several utilities undoubtedly yielded results which would have been of more than passing interest had they been published. In the 12 months ending in July, 7524 conversions were reported as being sold by natural gas companies supplying 38% of the meters on natural gas lines, while manufactured gas utilities with 80% of the meters sold 1713.

Gas-fired warm-air furnaces numbering 1761 were sold up to October 1, but these figures cover only a small percentage of the total made.

Boilers: Although new building dropped about 20%, the decline in cast-iron boiler business was considerably less than this figure, square boilers being off 2% from 1932, and round boilers declined 1.6%. A comparison of these indicates that the tendency of the round boiler to be displaced by the square type has been checked, for the time being at least. For the several years ending with 1932, the trend was distinctly toward the jacketed rectangular boiler, the round type showing a greater percentage decline each year as compared with the square type.

Continued inactivity in the larger types of non-residential building had its effect on steel boiler sales which dropped 15% from 1932, although here again the drop was not so severe as in new building.

The graph in Fig. 9 shows the trend of new orders of steel heating boilers for the past four years.

Warm-Air Furnaces: Although not definitely measurable from available figures, some indication of business in this field is furnished by the statement of one of the industry's spokesmen, who summarizes by saying that " . . . . in a general way during 1932 the volume was at its lowest point for many years. The first part of 1933 was also off, but the last six months showed a marked increase, and . . . . 1934 promises a very marked improvement."

Radiators and Convectors: Direct cast-iron radiators, probably as indicative of any other single product of the trend of business in the heating industry, lost 15% in volume in 1933 compared with the preceding year, see Fig. 10.

Non-ferrous convection type radiator business fell off 31% in 1933 from 1932. During the first 10 months of 1933 approximately 2,107,000 sq. ft. (equivalent direct radiator) of this type surface were sold, of which about one-third was in elements sold separately, the

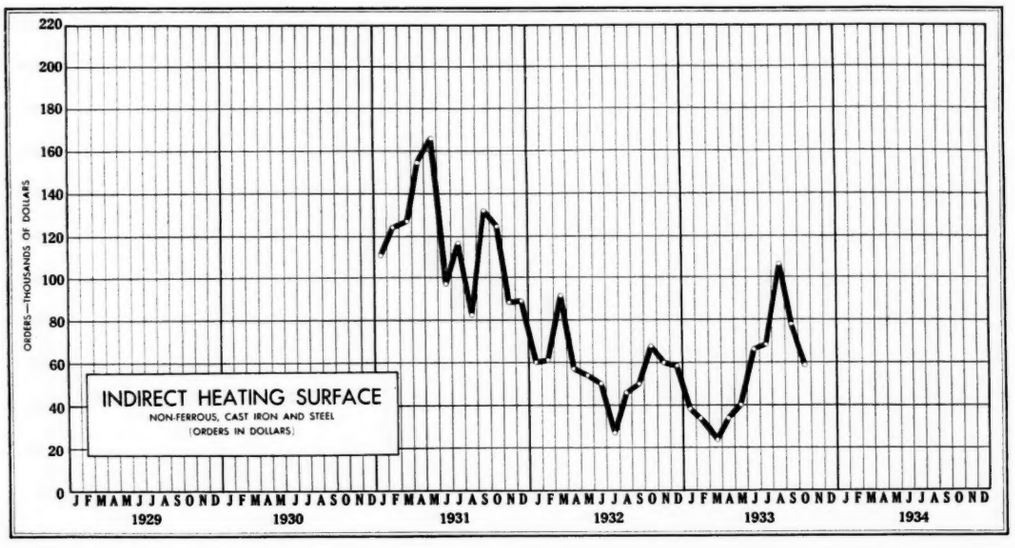

ORDERS—THOUSANDS OF DOLLARS
220
200
180
160
140
120
100
80
60
40
20
0
INDIRECT HEATING SURFACE
NON-FERROUS, CAST IRON AND STEEL
(ORDERS IN DOLLARS)
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1929
1930
1931
1932
1933
1934

Fig. 15. One of the features of the indirect heating surface business during 1933 was the increasing proportion of the total volume obtained by the non-ferrous type.

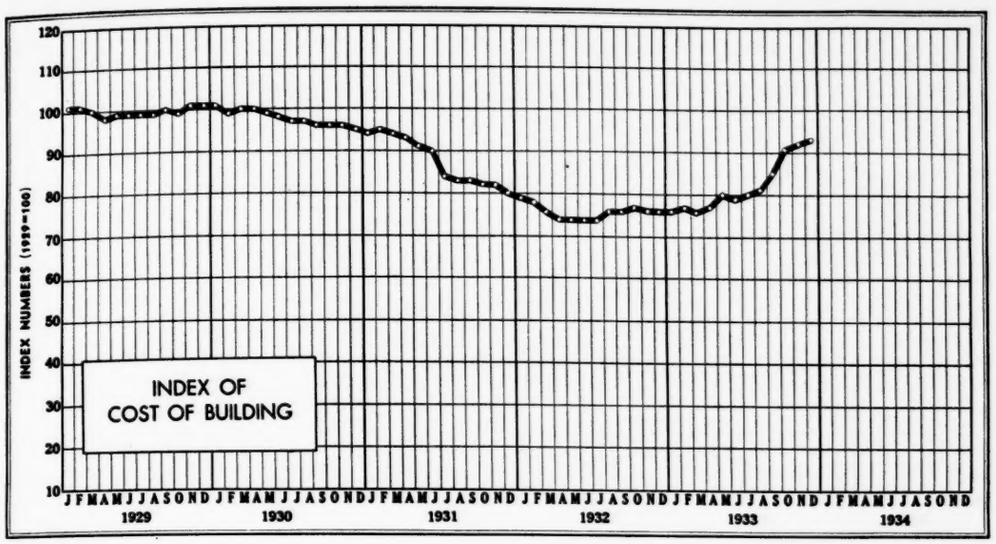


Fig. 16. An index which combines the two largest items of building cost—material cost and wages.

remainder being with cabinets and grilles. No figures are available on the sales of cast-iron convectors for 1932, but during the first 10 months of 1933 over 400,000 sq. ft. of this kind of heating surface were sold, the wholesale value of which was slightly less than $100,000. The dollar value, at the wholesale price level, of all types of convectors sold in the 10 months of 1933 was $237,000.

Convector sales are shown graphically in Fig. 11.

Unit Heaters and Ventilators: The boom in business in the mid-months of 1933 caused many industrial plants to modernize existing buildings and construct new buildings, resulting in an increase (previously mentioned) in industrial building, which in turn resulted in a rush of unit heater sales. For the first 10 months the total business in this line showed a gain of 9% over the same period of 1932, with a strong possibility that this gain would be still more when the 12-month period ends.

Similarly, the almost total lack of school building hit the unit ventilator hard, the volume of this equipment dropping 60% from the year before.

Figs. 12 and 13 illustrate the trends in unit heater and ventilator business.

Ventilating and Air Conditioning

Fans and Blowers: Ventilating work dropped to a new low during 1933 as is evidenced by the sales of blowers for use in ventilating systems which showed a 49% drop over 1932, see Fig. 14. Propeller fans, however, showed a 15% increase. Electric motors sold separately for use with ventilating fans and blowers declined 44%.

Indirect Heating Surface: Non-ferrous indirect heating surface continued during 1933 to gain a stronger competitive place in the heat transfer surface market. Sales showed a 20% gain over 1932, whereas the old type cast-iron surface dropped 72%, the most severe decline of any type of equipment on which records are available. A very small amount of steel surface was sold, and this type showed a decline of 18% over the previous year. The net result in all types of indirect heating surfaces was a drop of 3% over the preceding year.

The dollar volumes of sales of the three types of indirect heating surface—non-ferrous, cast iron, and steel—were in the ratio of 5:4:1. The combined total in dollars is shown graphically in Fig. 15.

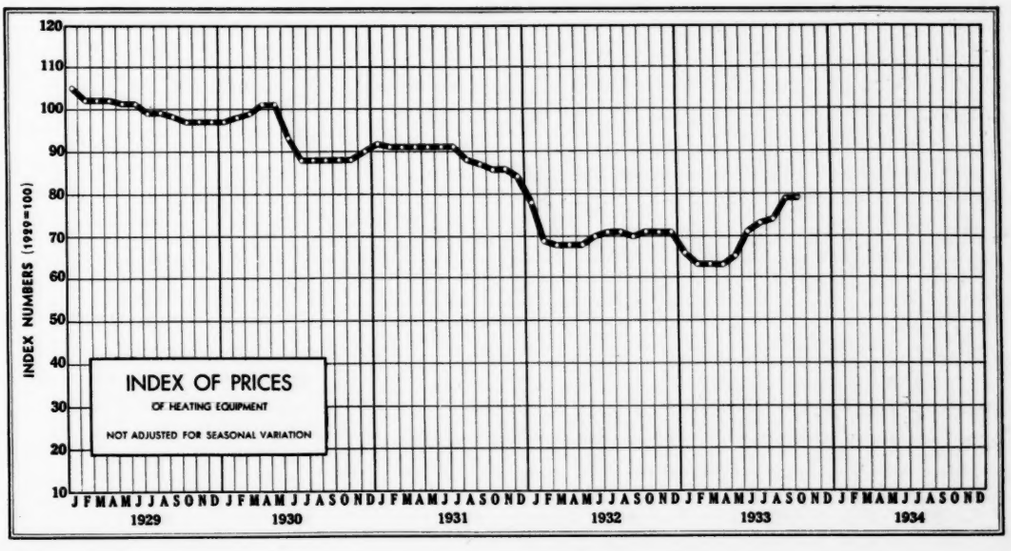


Fig. 17. Fluctuation in wholesale prices of heating apparatus.

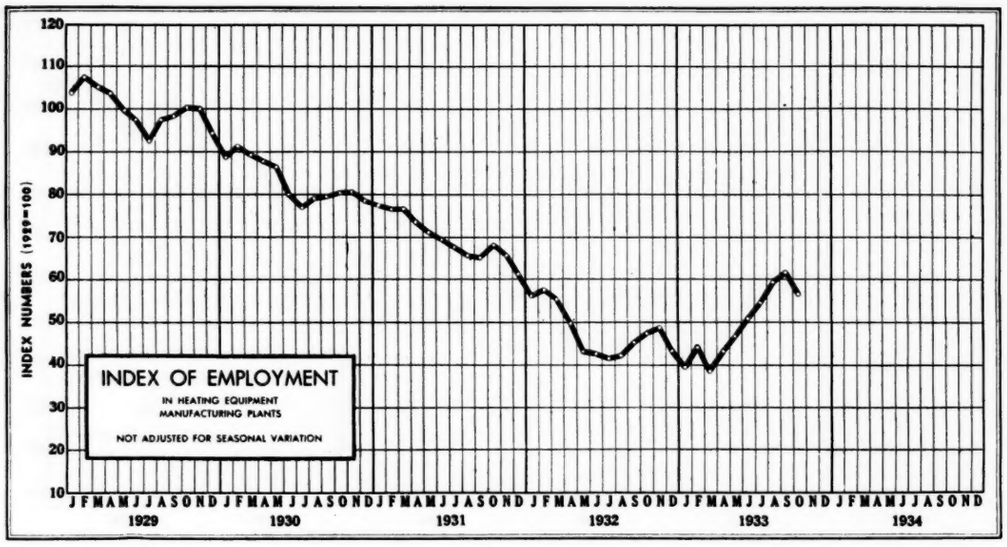


Fig. 18. The trend of employment in manufacturing plants engaged in making steam and hot water heating apparatus.

Air Conditioning Units: As was the case with unit heaters, the industrial pick-up accounted for an increase in the sale of industrial type unit air conditioners, sales of which gained 10% as compared with 1932. There are no definite records available on room cooling units but it is believed that this type of equipment was about equal to the 1932 sales.

Air Washers: Sales of air washers during 1933 declined 6% from the 1932 figures.

Cost of Building

In line with the rise in general price level, wages and materials entering into construction costs are rising, so that the cost of building is increasing steadily, as shown in Fig. 16. The trend in costs of heating equipment is clearly shown in Fig. 17, while the following tabulation of indexes gives similar data for average costs of all building materials.

	October, 1932	October, 1933
All Building Materials[5]	70.7	83.9
Heating Equipment[5]	67.5	74.7
Cost of Building[6]	159.2	187.7

Wages: Possibly the best indication of the trend of wages is that of the earnings of steamfitters. Their median rate in November, 1932 was $1.02 per hr. and in November, 1933, $1.03. However, the average of laborers employed by heating contractors fluctuated between 35-50 cents in 1932 to 40-45 cents in 1933.

[5]Bureau of Labor Statistics, 1926 = 100.
[6]"Engineering News-Record," 1913 = 100.

Trade Associations Performed Dual Function in 1933

DURING the year the status of trade associations and their work went through a most striking and important change. Heretofore their chief activities had been along lines of coordination, promotion, and the development of varied cooperative activities among their members. The National Industrial Recovery Act put a new problem and responsibility up to organizations of this kind. They were made important agencies in the preparation and administration of the proposed codes of fair practice. During the year these new duties became of such absorbing importance that in many cases they compelled an almost complete scuttling of other plans and projects. In some cases the older activities were merely postponed, in others they were continued on a curtailed scale, while in a few cases conditions permitted carrying out the old plans in addition to the new duties.

A second important result was also brought about by the recovery act. This was the almost immediate appearance of a great many *new* trade associations. In most cases these were organized purely as a result of the act and were for the purpose of formulating and administering codes. Being primarily occupied with this work they did not plan or carry out any other projects. Whether they will eventually do so or not remains to be seen. It is quite possible that hereafter we will have two distinct kinds of trade associations—one being almost purely code administering bodies, the other continuing to do the kind of work previously associated with trade associations. In some cases the same body will perform both functions.

The essentially different character of these two activities of the associations makes it desirable to discuss them separately. This is done by first considering the activities which are not primarily a part of the NRA codes and then passing to the code situation.

Heating and Piping

The Heating and Piping Contractors National Association, to give the name under which it started the year, continued its program of promoting the idea of modernization and continued to call the possibilities of this kind of work to the attention of members. The vocational classes which have been sponsored by the association in order to promote the adequate training of welders were continued. During the year, too, classes were organized to give practical instruction in air conditioning—a subject which became of increasing interest and importance to members. So true was this, that following the annual meeting the name of the association was changed to Heating, Piping and Air Conditioning Contractors National Association. An important part of the year's work consisted of the preparation of a series of 10 lessons on air conditioning which were published in pamphlet form and which were used as textbooks in the vocational classes in air conditioning. Material on air conditioning was also added to the Engineering Standards of the Association. Sales helps and sales suggestions on many kinds of equipment were supplied to members throughout the year.

Oil Burners

The American Oil Burner Association, not only in comparison to the work of many another trade association but also in its own right, emerged from the depression and the year 1933 as a strong organization backed by a membership willing to expend time and effort to see that the fruits of organization are properly harvested. Membership gained in prestige and number with strong new firms coming in and taking an active voice in policies and administration.

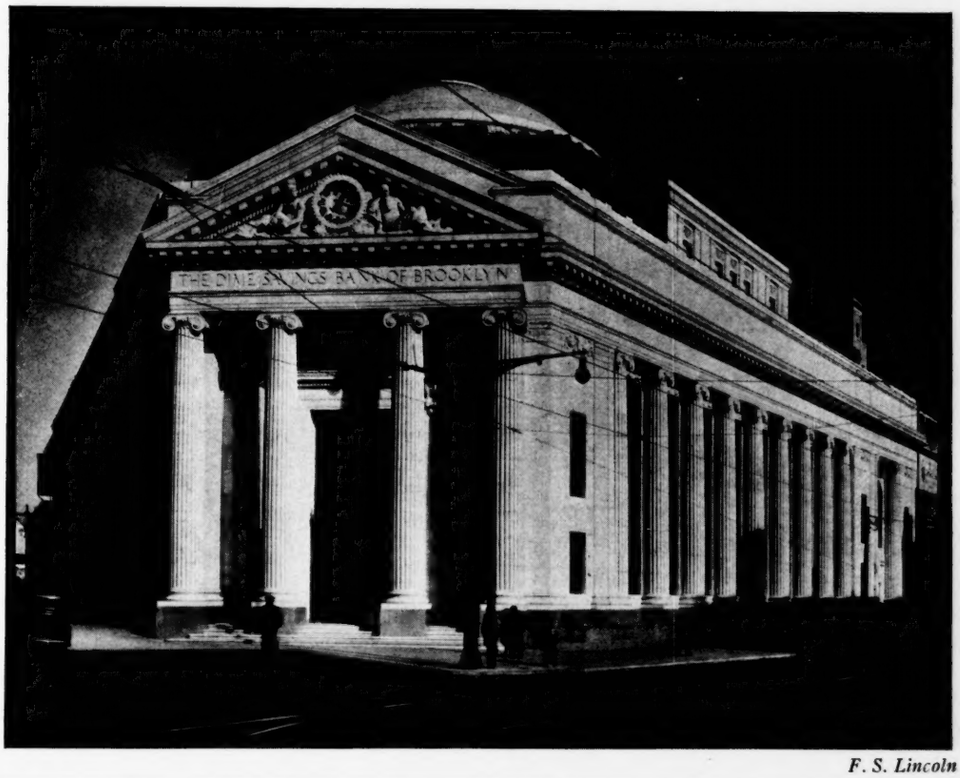
Among the important announcements made at the annual convention, indicating the viewpoints not only of the oil burner industry itself but also those in the accessory field, was the news that the Zoro Patent Estate had received further recognition in that the estate had withdrawn several suits because two large control companies agreed to recognize the estate and indicated that in the future they might refuse to sell controls to burner manufacturers not licensed under the estate.

Less heralded than events such as this and the development of an all-industry code, and yet of continuous significance to the industry, was the work of the A.O.B.A. in further advancing oil heat acceptance through many media such as newspapers, magazines, radio, and the lecture platform; the work of the association in the current "battle of the fuels," which was waged on several fronts by both the coal and gas interests; the completion of laboratory researches in cooperation with the A.S.H.V.E. at Yale University under the supervision of Prof. L. E. Seeley; the model ordinance activity which resulted in the further education of communities in the matter of adopting effective oil burner ordinances; the organization of some 18 new local oil heating associations; the continued expansion of enrollment in the dealer division, and the development of a low-rate blanket life insurance plan for all members of the industry.

Bituminous Coal

Efforts looking toward maintaining the position of bituminous coal as a heating fuel and of finding increasing usefulness for it have been made under the direction of the National Coal Association and the Committee of Ten—Coal and Heating Industries for some years. Both of these organizations continued their program during 1933.

In addition to the regular service to its members which the National Coal Association carried on uninterruptedly during the year, three matters received special attention. During the year 1932 a large part of its effort was directed toward the establishment of cooperative selling agencies, as a result of which Appalachian Coals, Inc., was organized. A test of the legality of that type of selling agency came before the Supreme Court early in the year and the association contributed



Air conditioning gains good will for customers of this New York bank. Comfort cooling was installed during 1933

F. S. Lincoln

its part toward the prosecution of the appeal to that court. As a result of the favorable decision Appalachian Coals, Inc., began to function on April 17.

The association then turned its attention to the inauguration of a research institute, under which investigation of the properties of coal and its utilization should be undertaken, and experiments with stokers and other coal-burning equipment should be carried on. Rapid progress was made toward the accomplishment of this object. However, the attention of the industry was soon diverted to the questions involved in the enactment of the National Industrial Recovery Act, the adoption of a code of fair competition for the industry under NRA auspices, and the establishment of machinery for the administration of that code. These questions were so momentous that they monopolized practically all the efforts of the association for a number of months and are still requiring a great deal of attention. With the settlement of the code problems still confronting the industry, the association will resume its effort to inaugurate a research program on a scale befitting the magnitude of the interests involved.

Despite the serious economic handicaps of the past 12 months, the Committee of Ten—Coal and Heating Industries materially strengthened its claim to recognition as one of the essential agencies for the advancement of solid fuels. While it was necessary to reduce the budget materially, curtail the bulletin service, and practically eliminate the field activities, the committee broadened its contact to include every state in the Union and a number of foreign countries. Meantime, an active correspondence service was maintained for all interested in satisfactory heat with solid fuels.

Over 25,000 copies of the bulletins in the educational series alone have been distributed to date. These bulletins cover such subjects as chimney construction, fireplace construction, certified heating, solid fuels in hand-fired plants, automatic coal heat with stokers, and comparative fuel data. Other thousands of miscellaneous and unclassified reports were distributed during the year, and in addition a monthly information bulletin was published and distributed to a large mailing list of key men in the coal and allied equipment industries. This bulletin carries items and data relative to the latest developments in solid fuel heating and to modern merchandising methods developed, not only by solid fuel folks but also by competitive fuel people.

Staff of the A.S.H.V.E. Research Laboratory, Pittsburgh: Paul McDermott, Carl Gutberlet, A. E. Kurtz, Director F. C. Houghten, and J. L. Blackshaw

The committee's Chicago office continues to serve as a clearing house for the various industries represented. Additional bulletins in the educational series are planned. About 15 subjects will ultimately be covered and upon completion will be incorporated into a manual.

Anthracite Coal

The Anthracite Institute and its allied Anthracite Laboratory have been carrying on investigations and studies looking toward improving the methods and equipment for using anthracite efficiently. During the year much important groundwork was laid with architects and engineers leading toward automatic heat in private homes and the heating of domestic water supply. Studies and surveys among homeowners were continued throughout the year, and the extent to which public interest inclines toward the various traits of competing fuels was quite thoroughly cataloged and cross-indexed. Thus, the engineering facilities of the institute became informed as to the target at which to shoot.

The gas producer, developed by the institute and announced by the trade and public press late in 1932, produces the cleanest, most uniform and most versatile industrial gas ever produced, according to Carroll B. Dotson of the institute. He places the cost at something less than 20 cents per 1000 cu. ft. commercial gas B.t.u. equivalent. It is being used in New England tool shops, ceramic and pottery works, etc., and while anthracite gas has never been exploited as a successor to city gas for household cooking, heating, or refrigeration purposes, it is a fact, states Mr. Dotson, that the institute has found real estate developments deeply interested in the possibilities of anthracite producer gas for large multiple-family dwellings.

At the Chicago Century of Progress Exposition the institute introduced the first completely automatic solid fuel-burning heating plant. This machine, developed by the laboratory, was also placed experimentally in the field and demonstrated that automatic household heating, even to the automatic disposal of ashes to any spot desired, and automatic feeding of coal from a year's supply in the bin, is an accomplished fact. The unit exhibited at Chicago attracted much attention, and a great many inquiries reached the institute as a result. In the meantime, experiments have been carried on in the institute laboratory for the development of completely automatic units which would use the larger sizes of anthracite.

Manufacturers of air conditioning apparatus worked closely with the laboratory during the year in the development of ways and means of hooking up the device with their equipment. The models placed in the field are so designed that such connections can readily be made.

Further developments include convenient water heaters for small homes. The laboratory produced a low cost unit for this purpose which gives almost automatic and highly efficient results.

Continued experimentation with Anthrafilt (anthracite fines used for water purification) are confirming earlier expectations of the scientists who have been developing that phase of the work of the institute. Several cities are using the product now for purifying drinking water and straining sewage.

Close cooperation between the laboratory and the U. S. Bureau of Standards looks to complete agreement as to standards for the production, installation, and operation of all equipment used in the consumption of anthracite. The first results of this cooperation are full agreement on standards applicable to domestic stokers. Step by step the institute looks to effect the same harmonious understanding with the Bureau of Standards on other items of interest to the industry.

Gas as a Heating Fuel

Heating by gas made decided strides forward during 1933, according to a summary statement furnished us by C. George Segeler of the American Gas Association. He adds that the results everywhere were considerably better than during 1932. He attributes this in part to generally improved conditions, but feels that the greatest influence was the introduction of new and lower rates. As stated in the September issue of HEATING AND VENTILATING, page 11, the rates have steadily declined, and 1933 witnessed the introduction of attractive rates in many new localities. Notable results in sales were reported from Schenectady, Philadelphia, Washington, D. C., Webster Groves, and Baltimore. The present governmental plans for raising of prices and inflating the currency, Mr. Segeler feels, should be of benefit because of the lag between price rises and increases in the rates charged for gas. Consequently, the immediate outlook is one of increasing sales of gas for heating purposes. This has generally been recognized by gas executives, who feel that house-heating is one of the most important load building possibilities, especially in centers where the cost of distributing gas is low.

The campaign for house-heating business in Chicago was especially outstanding, as more than 10.475 gas heating installations were sold during 1933. These installations were made on very attractive terms, involving a combination of rental and part payment plan, as well as the low cost of gas.

The break which occurred during floods that washed out the Denver-Texas natural gas pipe line provided ample opportunity, states Mr. Segeler, to show how the gas company will meet the problem of gas shortage if it should ever arise, either because of pipe line breakage or actual depletion of the natural gas supplies. Within an incredibly few hours, gas service was restored in Denver following the flood, using a new type of oil gas of high B.t.u. value as a standby fuel. This new development greatly enhances the value of natural gas wherever it is available, since it can be substituted when necessary without any change in burner adjustments.

Seven railroads are served by Cincinnati's new Union Terminal, Completed early in 1933

He further calls attention to the fact that the general trends in gas heating seem to favor the installation of conversion burners, especially in existing boilers, although new designs of integral gas units are being pushed forward rapidly, especially with a view to producing de luxe high efficiency equipment surpassing anything now available. A step in this direction was the introduction of the damper regulator, which is a device completely shutting off the chimney and the flow of warm air from the basement during the off periods of the burners, with a resultant saving of nearly 10% of the annual fuel consumption.

It is interesting to contrast the trends in gas and oil heating, since gas heating started with the strictly gas-designed units and seems to be veering toward the conversion burners as every large producer of gas boilers and furnaces also makes conversion burners as well. On the other hand, the oil industry seems to indicate a contrary trend, the all oil-designed units coming into use at a later date than the conversion burners.

In the field of air conditioning, gas continues to make notable advances. The most important of these is the recognition of dehydrated air as a type of air in itself, a classification quite separate from refrigerated air which was originally held to include all types of conditioning air. The importance of dehydrated air, especially in industrial applications, is being recognized and new uses found for the gas dehydrated air. The latest of these is in the shoe industry, where leather is treated in conditioned air during the process of manufacturing. In the air conditioning of buildings and residences, the successful operation of a restaurant in Jamaica, N. Y., and a new residence installation in Philadelphia serve as milestones in the progress of this new development. Looking back over its history, it

started as a combination of stationary dehydrated bed with water cooling, which was soon replaced by the more efficient rotary bed. The office building at Dallas, mentioned in last year's review, was a combination of rotary bed dehydration with water cooling supplied from an interior water tower. In 1933 the first restaurant installation was made, a combination of rotary bed and water cooling, but it remained for the Philadelphia installation to be the first residence in which the rotary bed was combined with re-evaporative cooling.

The American Gas Association Testing Laboratory is continuing its active work in research and testing programs, the latter having been extended to cover the listing of conversion burners as well as continued tests on space heaters of all kinds, central heating appliances, unit heaters, garage heaters, in addition to the previously tested groups of appliances. The blue star on a gas appliance continues to assure the safety, efficiency, and durability of appliances approved by the laboratory.

Electric Utility Work

The electric utilities, through Edison Electric Institute, have shown increasing appreciation of the load possibilities of all the apparatus used in heating, ventilating, and air conditioning. Of late their interest has focussed on air conditioning to a considerable degree. Looking ahead for load building opportunities, the utilities see the expansion of air conditioning service in the commercial and industrial fields as one of the outstanding possibilities. The next step, writes C. E. Greenwood of the institute, will be broad scale application in the better dwellings at such time as the economic situation clears and will permit home building again.

Committees of the institute have directed attention to the present status of air conditioning. During the past summer a preliminary report on domestic air conditioning was published, dealing in particular with portable types of apparatus for room cooling. In 1932, a report on commercial installations was released including operating data on a large number of installations.

An exhaustive study of the entire subject of air conditioning is in progress. The outline of procedure includes such topics as determination of a utility definition of air conditioning to be recommended to the industry; collection of information on the uses of air conditioning equipment; types of apparatus for the purpose required, and specific approach to meet sales resistance; collections of sales and promotional methods that have proved successful and recommendations pertaining to the same. The general survey will also include compilations of technical data, and the study and investigation of new equipment and methods.

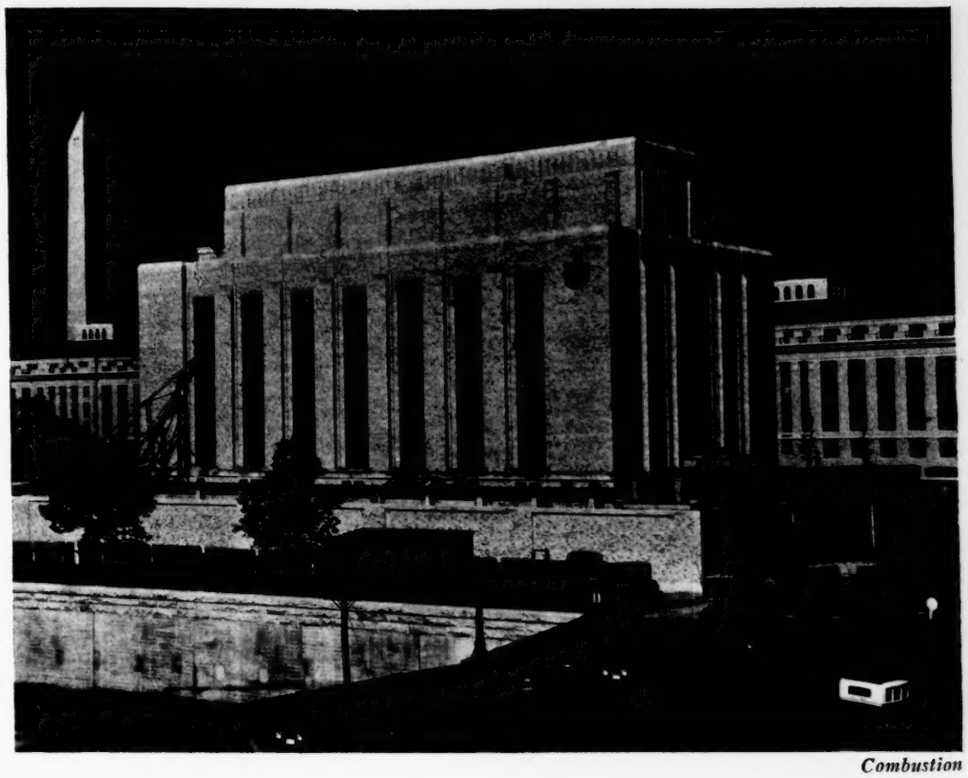
Recognizing that a brisk business cannot be expected now, groundwork will be laid for national coordinated action at some opportune time. The consensus of opinion of the utility commercial groups seems to be that business can be sold this valuable service, and the health and comfort factors in room cooling assure a market of wide proportions when mass educational and sales effort is put behind them.

Warm Air Heating

The National Warm Air Heating and Air Conditioning Association has not only long been exceedingly proud of its research work performed at the University of Illinois but its members have been aware of the lasting values which have come to them as a result of it. It is not surprising, therefore, that in spite of adverse business conditions early in 1933 they should feel that this work must be continued. Not only were they able to continue the heating studies but the summer cooling project begun in 1932 was also continued during this past summer. Thus another of the most worthwhile of the activities of any trade association was able to keep going throughout the year. It is pleasant to note, too, that this faith was justified for the secretary informs us that during recent months there has been so marked an increase in business activity that the association feels confident that plans can not only be continued but extensions may be possible.

Ewing Galloway

Making way for a public building in downtown New York where a new post office will be erected as part of the Government's Public Works program



Heat for Government offices will be supplied from this new central heating plant in Washington—one of the year's outstanding achievements in heating plants

Combustion

During the past few months the Tentative Code for the Installation of Mechanical Warm-Air Furnace Heating Systems in Residences was revised and a new edition published, and the word "tentative" was removed from the title. This, too, represents a forward step in the work of the association.

During the year, too, the association encouraged and assisted the development of new apparatus and the modernizing of older lines, found time to improve market conditions and promote the popularity of warm-air heating.

Building Owners and Managers

For some years the annual Experience Exchange Report of the National Association of Building Owners and Managers has been a means of encouraging better operation of building plants, while the standard record forms developed by the association to promote the keeping of accurate records have been a help in bringing about better record keeping. It is a pleasure to report that both of these activities were continued during 1933. The Exchange Report for 1933 showed operating costs in buildings totalling over 43 million sq. ft. of rentable area in 55 cities in the United States and Canada. For 1932 the average cost of heating was 6.5 cents per sq. ft. of rentable area.

The association continued to cooperate with the A.S.H.V.E. on committee work and with the National District Heating Association. It reports a willingness to cooperate with all interested parties. The monthly publication of the association, *Skyscraper Management*, has helped to popularize both heating and air conditioning during the year and carried informative articles on both subjects.

The impressive record of accomplishments of the trade associations even during the difficult year just ended—quite aside from their NRA code activities—shows how important is their work in advancing not only the interests of their members but of the whole industry and all connected with it. Each year they are becoming increasingly important factors in the general picture.

The Trade Associations and NRA Codes

The National Industrial Recovery Act was signed by the President on June 16, 1933. Almost at once codes of fair practice as outlined under the terms of the act began to appear. Other trade groups which had no such codes drawn up began to look about for advice and counsel. It seemed evident that not only would there be advantage in having a code because of the relaxing of the anti-trust law provisions for code groups, but the weight of public opinion was obviously on the side of trying out the proposals of the act.

At first all was confusion. Established associations took immediate steps to get a code drawn up and filed. Groups which had no trade association hastily formed one and proceeded to get a code drawn up. In spite of all the confusion and all the organization work necessary, not to mention the tedious process of drawing up a detailed code by a conference method, progress was rapid. Groups were urged to make haste. Business began suddenly to boom in some lines. Decidedly, things were looking up.

No sooner were the codes on file, though, than the physical difficulty of getting enough staff and space to permit rapid public hearings bobbed up. Code progress began to slacken. There was dissatisfaction on the part of labor and there were bickerings and jealousies among the industry groups. Farmers did not like the way the prices of their products were going. NRA was in serious trouble.

Suddenly the President moved to bring all industry into line quickly by his emergency agreement. This took time. So, too, did the work of attempting to lay down basic policies within the NRA organization, and the necessity of reselling the farmers on the worth of the program.

The net result is that at the year-end many of the codes drawn up so promptly in mid-summer when the pressure was on are still awaiting action.

This period was not entirely wasted though. All through it discussions went on, details were adjusted, viewpoints were aligned, and some comprehensive plans have been outlined. Moreover, a few codes have gone into operation.

Who Submitted Codes

A check-up shows that upward of 30 separate codes were filed with NRA during the past few months which either directly or indirectly belong within the heating, ventilating, and air conditioning industry. A complete check is virtually impossible for comprehensive listings have never been made public, and it is difficult to confirm the fact of actual filing in the case of some codes drawn up by small groups. Moreover, especially in the early weeks, there was a great show of secrecy about the codes and their detailed provisions. Some codes which were filed have been withdrawn and in a few cases there have been consolidations of groups who have merged their code interests with others. A detailed and accurate list of all filing agencies is therefore not available at present.

Codes in Effect

The vertical code submitted by American Oil Burner Association was approved September 18. (Printed in full in HEATING AND VENTILATING, pages 24-27, October, 1933). This code governs not only the manufacture but the distribution of oil-burning equipment as well. The Code Authority is organized and fully functioning.

Others in operation are those submitted by the National Association of Ice Industries, Steel Heating Boiler Institute, Hydraulic Institute, American Boiler Manufacturers Association and the Heat Exchange Institute.

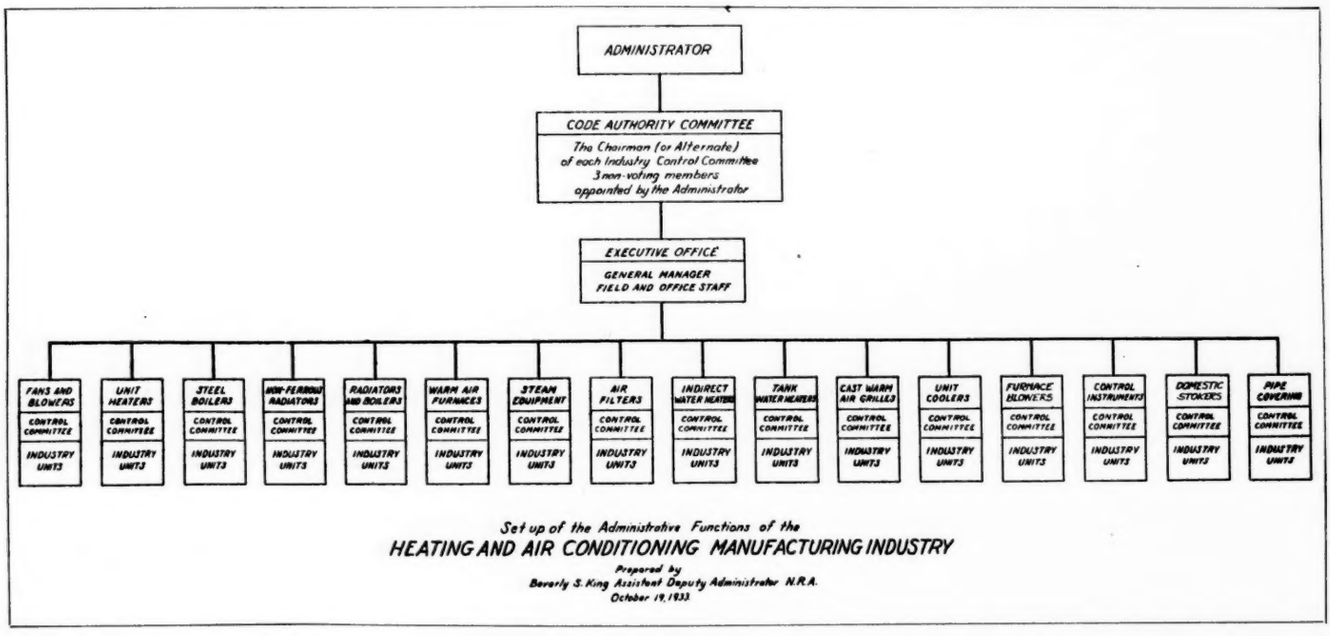
The Construction Code

For several months the construction codes in which contractors and engineers are especially concerned have been on file. Public hearings on them were held early in the fall. Since then progress has been held up by the determined opposition of organized labor. Labor rests its case against these codes on two principal objections. One is that the minimum wages and maximum hours of work as set will not bring about the results desired, while the other is that labor is not represented on the administrative boards proposed. Labor also feels that a comprehensive construction code is not in its interests and insists that building construction should not be grouped with construction of other types. Attempts to bring matters to a head have not been successful. There is little to do but be patient. It seems apparent, too, that organized labor desires nothing more than to postpone approval of the construction code until after Congress meets. Labor is strong in Congress and probably hopes to bring pressure to bear there to gain its ends.

The Basic Manufacturing Code

One of the important developments in the relations between the trade associations and the NRA codes is the proposal which was advanced some time ago for the coordination of manufacturing codes under one basic code for the manufacture of heating, ventilating, and air conditioning apparatus. Such a plan has been under discussion for some time but conversations were private and negotiations had not reached a stage where the details could be made public.

Now through the courtesy of Beverly S. King, Assistant Deputy Administrator, NRA, who suggested the



Set up of the Administrative Functions of the
HEATING AND AIR CONDITIONING MANUFACTURING INDUSTRY
Prepared by
Beverly S. King Assistant Deputy Administrator N.R.A.
October 19, 1933

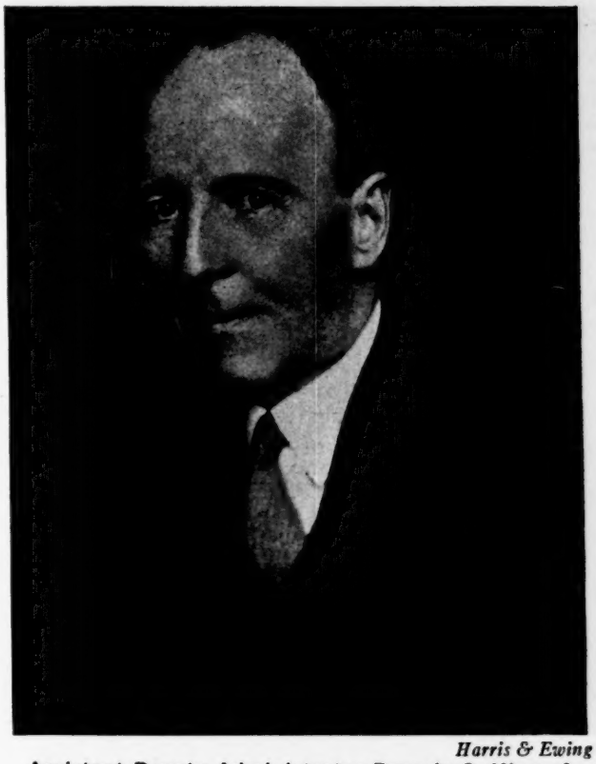
plan and worked it out, we are able to give its principal features.

The general proposal is shown graphically in the accompanying chart. A Code Authority Committee would be set up composed of the chairman of each industry control committee (or his alternate) and three non-voting members appointed by the Administrator. In Mr. King's chart 16 divisional groups are shown. Each of these would have its own separate code and its own divisional code authority. Each is in effect a trade association which sponsors and administers its own code through a Control Committee responsible for the actions of the members of its particular group and reporting to the Code Authority Committee of the Master Code.

The actual details which would make this plan possible have been worked out and incorporated into a proposed code to be submitted by the Heating, Ventilating and Air Conditioning Institute—a body not yet formally organized. Membership in this institute would be made up of the several trade associations which subscribe to the plan and which sponsor the several divisional codes provided. The proposed code is now in printed form and available for discussion by the interested groups in order that they may approve, amend, or reject it. If adopted by these groups it is expected that the master code of the institute will be submitted to the President for approval. If approved it would become binding on all members of the industry.

It is important to note that this proposal does not abolish or do away with the divisional codes. It merely sets up a master, basic code and provides for a coordinating administrative body. Where presidential approval of divisional codes is already in effect, the proposal is that they be modified in detail where necessary to conform to the master code requirements.

The proposed code, as printed under date of November 26, 1933, is lengthy. It names the following divisions as being immediately established: (a) Fan and Blower Industry, (b) Unit Heater and Unit Ventilator Industry, (c) Cast-Iron Boiler and Cast-Iron Radiator Industry, (d) Non-Ferrous and Steel Convector Industry, (e) Warm-Air Furnace Manufacturing Industry, (f) Steam Heating Equipment Industry, (g) Indirect Water Heater Manufacturing Industry, and (h) Warm-Air Register Industry. In addition the following are mentioned as eligible: Air Filter Industry, Unit Room Cooler Industry, Heat Exchange Industry, Steel Boiler Industry, Radiator Cabinet and Cover Industry, Heat and Moisture Insulation Industry, Domestic Automatic Stoker Industry, and Control Instrument Industry. Others of like nature are also eligible.



Harris & Ewing

Assistant Deputy Administrator Beverly S. King of NRA, who proposes a plan for unifying the heating and air conditioning codes

The printed code is arranged in the usual form and sets forth the duties and powers of the Code Authority, the rights of labor, minimum wages, maximum hours, and lists 15 unfair trade practices.

It appears that such a coordination of the divisional codes under a central institute would permit each to participate with an equal voice in the Code Authority Committee while retaining individuality, self-government, and policies. Savings in cost of administration should be secured, and united coordinated action would be possible.

While the trade associations have thus put in some strenuous months in laboring on the NRA codes, it is clear that they enter the new year with some uncertainties and with weighty and important decisions still to be made.

Rounding Out of Makers' Lines Highlight of New Equipment Review

IN a year when business volume shrank markedly it would not be surprising if the number of items of new equipment offered also fell off. Examination of the New Equipment pages of HEATING AND VENTILATING does not show any corresponding reduction. Fewer items were reported in 1933 than in 1932, but only slightly fewer. Evidently there are still plenty of equipment makers who retained their faith in the future and who went right ahead with their plans despite the lack of business volume.

Not only did the actual number of new devices remain nearly steady as compared to the previous year but new manufacturers continued to be attracted. The attention directed to air conditioning and the continued

interest in it undoubtedly account for the appearance of most of the new company names. More company names new to the heating and ventilating field appeared with air conditioning products than with all other classes of equipment combined. During 1932 it appeared that everyone interested in air conditioning had entered a product and it might reasonably be expected that the rush was over. Events have not borne this out, for nearly as many new firm names of those who are sponsoring air conditioning products are in the 1933 list as on that of 1932. This continued interest in air conditioning as a field for new products is one of the outstanding tendencies. Whether it will carry through another year is an important consideration to those already in the field, for with each entry the competition becomes keener.

Examination of the new equipment also brings out another important point. Business was selective during the year, probably more so than in any recent period. If a manufacturer wanted to get business he stood the best chance by having either a full line of products or else he had to be sure that his line included items for which there was a market. As a result there was a great deal of shifting about and attempts to find suitable products. Low-priced items which would furnish a small unit sale were at a premium. Many firms who had not had products of this kind proceeded to add them. Equipment of this general kind accounted for many of the items which were sponsored by firms long established as makers of heating and ventilating devices and systems.

Fuel-Burning Equipment

While this tendency was marked throughout the whole range of equipment items announced during the year, nowhere was it better shown than in the activity in devices for use in burning oil. Oil continued to be low in price throughout the year and the impetus which its use had received during previous years carried over. As a result, the demand for this class of equipment held up well. One of the consequences was that there was a notable tendency for manufacturers to find a product which could fit into this field.

In the use of oil for heating buildings two tendencies are notable. One is that with so many installations already made, the cream of the conversion market has been taken off. The other is that it is coming to be more and more realized that lower-priced equipment offers a good opportunity for making more and more oil-burning installations.

Realization that there is an appeal in furnishing both a furnace, or boiler, and burner at the same time, caused the appearance during 1932 of a considerable number of boiler-burner and furnace-burner units. This movement was not complete at the end of 1932 and carried over into the past year. In fact, it became so marked that now virtually every boiler manufacturer and a good many furnace makers have available special designs for use with oil. Some of these are the products of old established firms who for years concentrated their attention on the larger sizes.

Boiler-Burner Units. To look at the figures involved in this tendency is interesting. During 1933 not less than 14 boiler-burner units were announced in domestic sizes. Combined with half a dozen already announced during the previous year there are now on the market not less than 19 boiler-burner units of essentially similar size and essentially competitive with each other.

Practically all of those announced during the year were vertical and enclosed in a rectangular or cubical sheet metal casing, which was finished in an attractive and artistic fashion. There was no preference between iron and steel designs so far as number is concerned, for of the 14 announced seven were steel boilers and the other seven were cast-iron.

This development of the boiler-burner unit is interesting in a number of ways. For one thing, the announced name of the combined unit is usually that of the burner maker and not that of the boiler manufacturer. In some cases both names were used. More often, however, the burner maker makes no mention of the fact that he is being supplied with his boilers by some other manufacturing organization. Quite obviously in some cases the idea is to market the combined unit through the sales organization of the burner manufacturer. In these instances, this means that the boiler manufacturer is becoming a "parts" maker, turning his finished product over to someone else to market. Just what effect this may have on his relations with the established contracting outlets to whom he has so long looked for sales remains to be seen. Installation work in connecting up the boiler to the heating system is still required, the same as always, and while the boiler-burner unit is announced as a unit, it often really reaches the site in two separate shipments. In some cases when cast-iron sectional boilers are used they are still assembled on the site.

It is worth noting that this whole movement toward furnishing the boiler and its burner all as one unit has come about during the course of the past 18 months. The movement in this direction carries with it a great many interesting possibilities and can be considered as one of the major tendencies of the year.

This activity in the burning of oil and the appearance of so many boilers and furnaces especially for use with it has meant that practically all manufacturers have found that they must widen their lines in order to include such a design. As a result, 7 manufacturers during the year announced additions to their lines, making special boilers for use with oil available. A check-up

shows that at the present time there are not less than 28 makes of special oil-burning boilers now on the market. In the main, these moves are all on the part of old established firms and this movement has not attracted any sizeable number of newcomers.

Furnace-Burner Units: The boiler-burner unit has had something of a counterpart in the warm-air furnace field for, during the year, two manufacturers brought out special units for use in warm-air heating which incorporated an oil burner practically integral with the furnace. The popularity of oil burning is also reflected by the fact that four makers of warm-air furnaces brought out special steel furnaces intended for use with oil burners.

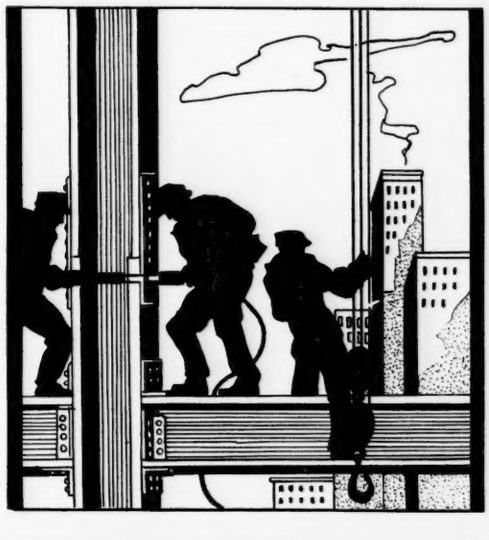
Gas Conversions: In the field of gas-burning the conversion burner became more firmly established during the course of the year. Several utility companies put on drives to encourage the installation of this kind of burner. Two manufacturers of gas-fired boilers and furnaces announced burners as additions to their line. The result is that now virtually every maker of gas-fired equipment is able to offer a conversion burner when desired.

It is not possible to pass over this situation without calling attention to the very sharp difference in the trends where oil is burned and where gas is the fuel. The oil equipment is moving in the direction of a special design of furnace or boiler to accompany the burner, while the gas equipment, which started out with this practice, seems to be moving away from it toward the conversion burner.

Oil Burners: The oil burners announced during the year reflected the tendency of getting into the small sized building. Of the burners announced as new models, nearly all were of the pressure type as opposed to the rotary, and were an extension downward in size.

During the year, too, a number of oil burner equipment makers began paying attention to the possibility of obtaining business at the upper end of the scale. As a result, several extended the size of their burners upward. It must be kept in mind that the most fiercely competitive area is in between the extremes of size. Some burner makers have considered it good policy to put themselves in a position to attract business from sources where competition is not so fierce.

Stokers: Stokers continued to appear throughout the year, although in numbers the rush was not so great as in past years. One additional stoker-boiler unit under automatic control was announced in sizes running from medium to large. There still seems to be a tendency to pay a good deal of attention to stokers for use with the small anthracite sizes, and the underfeed screw is still common in these designs. One stoker manufacturer began to feature a conveyor arrangement for feeding coal from the bin and a separate conveyor for disposal of the ash.



During the year a prominent coal mining corporation built a demonstration house in which it incorporated coal-burning equipment specially developed to use coal in supplying all of the utility services of the building. A number of other equipments of this general kind are reported to be installed in various localities. For several years it has appeared that marked developments in coal-burning equipment were in the offing but they have been slow in materializing. There is some reason to believe that before long they will make their appearance in force.

Air Conditioning

Air conditioning equipment announced during the year not only reflected the nature of the expected business but was also influenced very largely by the state of the art in general. Following the great amount of publicity which the subject received in the past two or three years there has been rather keen interest on the part of the general public. Actual commercial progress has been hampered, however, by high costs. In a year when much of the business was obtained in small units and when income was low, this high cost was a matter of special concern. For that reason, a good deal of the year's apparatus represents attempts to overcome the cost difficulty in one way or another.

Humidifiers: One of these attempts has resolved itself into bringing out units for accomplishing one purpose only. As it seems that the idea of humidification is the one most easily sold it is not surprising that humidifying devices continue to appear. No less than 13 were announced during the past 12 months. Most of them were simple and aimed at a low first cost, more emphasis being placed on the portable types than on those requiring elaborate installations. Several of the vase type put in an appearance as well as a number to be attached to existing radiators. It cannot be said that any major developments in the idea of humidifying took place. With the addition of the 13 humidifiers which appeared during the year competition can be expected to become increasingly keen.

With industrial activity at a low ebb, very few pieces of apparatus intended for application to air conditioning in factories were brought out. The emphasis was all on the side of comfort conditioning.

Filters: Devices for filtering air continued to receive a good deal of attention. Eight of these made their appearance, four representing the entry of the firm into the field. All except one were of the unit type in which some filtering substance is built up on a frame and intended for installation in multiple. The great search seems to be for low-priced units which can either be cleaned readily or discarded entirely when dirty.

Cooling: Refrigeration for air conditioning continued in the limelight because, among other reasons, it is expected that the cooling feature of air conditioning will be specially popular. The steam jet method of cooling water

which is a comparative newcomer continued to receive the attention of manufacturers. Three announced a line of standard equipment for this purpose. With their entry, some eight or ten manufacturers now have steam jet apparatus available.

Several of the long established refrigeration machinery makers took increasing notice of the importance of air conditioning as an application for refrigeration machinery, and redesigned older machines to make them more applicable or else announced entirely new lines of machines. Freon as a refrigerant received a good deal of attention.

Nearly all manufacturers of commercial compression machines turned a critical eye on the size range which could be expected to find use in air conditioning, and arranged their standard lines so that as far as possible the same machines could be used both for air conditioning and for medium-sized commercial cooling work.

Several manufacturers developed complete apparatus for accomplishing both heating and cooling with the refrigerating machinery coordinated with the conditioning unit. On compression machinery the advisability of keeping the number of liquid connections at a minimum led to increased interest in air cooling of the cylinders to do away with one set of liquid connections.

Fans: The increased use of small-sized fans for comfort conditioning resulted in fan manufacturers laying stress on such wheels and complete fans as would fit into this kind of work. Several appeared arranged especially for application to air conditioning. There was no major redesigning of the general lines of fans on the part of the established makers—but extensions and changes in detail were made as found necessary.

Unit Heaters: Unit heaters and unit ventilators were not so much in the limelight as a few years ago. Some of this is no doubt due to the nature of the year's business with industrial building at a low ebb. The general idea of mounting a fan behind a heating surface inside an enclosure was followed out by a number of makers who brought out small portable units in which the heating is done by electrical energy. These units are more for spot and emergency heating than for any other application.

Central Plants: Basement, or central, conditioning units in small sizes continued to appear. As a good many of these devices were already available for attaching to warm-air heating plants it was not to be expected that a great number of them would continue to come on the market. This was borne out, as only a small number appeared during the year. In the main, these were of the fan-and-filter type, built into a sheet metal enclosure, with motor mounted outside. Those intended for attaching to steam or hot water heating plants showed considerable diversity in their design. One had an arrangement for accommodating 300 lb. of ice in the enclosure; another had space available in the bottom for mounting a compressor; while a third was so arranged that it could be attached to a steam or hot water boiler, or to a warm-air furnace, as desired.

Room Units: Probably the most significant development of the year was the large number of attractively finished floor-mounted metal cabinets for use directly in the room to be conditioned. Ten of these appeared during the year. They were of two general kinds: (a) those in which a compressor was mounted in the bottom of the cabinet and (b) those which contained only heat exchange surface, fans, filter, etc., and to which a remotely located compressor could be connected. In the case of those containing a compressor in the cabinet, several were mounted on rollers to make them portable.

As it is recognized that high first cost was one of the drawbacks in making sales of this kind of unit, attempts were made to keep the cost down by a minimum of field installation work and by simplification of the field engineering required. In connection with this, several units carried a feature of using flexible connections, and in one case, drain connections were eliminated by a device for putting the drip water into the stream of circulating water. The necessity for quiet operation in these room units was recognized and a good deal of attention was given to the grilles and to the sound-proofing of the cabinet, quiet operation of motors and fans, and so mounting them that vibrations would be eliminated or deadened.

During the year the first direct room unit making use of the reversed refrigeration cycle put in an appearance. The reversed cycle has been drawing attention for several years and the progress of the first commercial unit application will be watched with interest.

Heat Exchange Surfaces

Heat exchange surfaces and materials provided some interesting developments during the year.

In air conditioning cabinets where there is a fan to produce forced circulation over the surface, the non-ferrous extended type continues to be popular. Where these cabinets are designed for both heating and cooling either two separate sets of surface were used, or, in some cases, separate coils of pipe were carried through the same set of fins. This permitted some space saving and is a development worthy of note.

Radiators and Convectors: For some time, this same type of non-ferrous surface attracted a great deal of attention when placed in cabinets where there was gravity circulation. In 1932 finned cast iron had reached such a state that one manufacturer announced a line of cast-iron finned heaters suitable for recessing in enclosures with gravity circulation. This was followed during this past year by announcements of surfaces similar in principle by two other makers. Two makers also announced designs wherein the enclosure was cast substantially integral with the surface itself. Flues

were provided in the castings for directing air currents across them and out into the room. Tubular cast-iron radiators continued to appear with water pans cast into them. In most cases they were so arranged that the presence of the pans was concealed and to outward appearance the radiator resembled closely the traditional tubular radiator.

Indirect Heaters: Blast heaters, using copper tubing, spirally attached to metal fins were announced by two makers. One of the oldest firms in the field brought out a line of finned non-ferrous heaters and metal enclosures.

Heating Specialties

Hot Water: Heating by hot water has been rather dormant for some years so far as announcements of new equipment of a radically different type are concerned. During the past year no less than four makers of specialties for use in connection with hot water heating systems announced either devices or hook-ups which are considerably off the beaten path. They had to do with methods of making hot water heating systems more responsive to their control, taking them out from under the influence of purely gravity circulation. The general method is to keep a considerable quantity of hot water in the heater ready to start circulating as required by the operation of the sensitive control devices. An ingenious method of creating a vacuum by non-mechanical means was also included in the announcements of the year.

Steam: Specialties used in connection with steam and hot water heating systems did not provide anything like the number of new devices which has been associated with them for so many years. One new boiler return trap appeared, as did a number of improvements in design of air venting valves. Several new inverted bucket traps made their appearance.

Pump makers did not contribute heavily to the year's new equipment. One automatic priming device appeared; one line was redesigned, and a new condensation return pump was announced. One maker also brought out a vacuum pump of small size.

Apparatus for heating water showed the influence of the increasing popularity of oil as a fuel. The new equipment announced practically all made use of kerosene or light fuel oils, and used a burner of special design in connection with a storage tank and under automatic control.

Controls and Instruments

Ever since controls and instruments received their initial impetus with the rising popularity of the oil-burning developments they have continued to appear at a rapid rate. This is true of 1933, when more controls and instruments were announced in the new equipment pages of HEATING AND VENTILATING than were items in any other group. In fact, more of these devices appeared during the past year than during the preceding one.

Temperature regulators, thermostats, and temperature-actuated devices continued to make up the largest single group. Two controls appeared governed by outside temperature, as did four which control on the basis of both temperature and time. Power-operated valves—so essential to automatic operation—were brought out by eight different makers. In the main, the actuating power was electric, both solenoid and motor-operated valves being represented.

The control of draft occupied a prominent place in these announcements. Controls for stoker operation were included. Float-operated devices of various kinds were also prominent. Three new low-water cutouts for use on boilers put in an appearance. One combined a low-water cutout with a pressure limit control, while another incorporated an automatic feed mechanism.

Ever since humidity has received close attention, there has been a search for suitable humidity control devices. This continued last year and four different makers announced humidistats based on various principles, and using diverse materials as the sensitive element. One used human hair, another used paper, while a third used laminated wood.

Manometers intended to measure either very small pressures or very slight pressure differences appeared with indicating devices, and also so arranged that electric circuits could be opened or closed by the pressure fluctuations. Two steam flow meters appeared, as did one meter for measuring flow of liquids and intended especially for application to refrigerating lines.

Motors

The manufacturers of electric motors have been keenly aware of the demand which newly developed apparatus in air conditioning has made for suitable motors. During the year three makers announced new designs of fractional horsepower motors of the capacitor type, while another brought out a line of polyphase motors in small sizes. A number of models for special applications, such as to stoker drives, were included in the new equipment announcements. Of interest, too, was the development of a number of new V-belts and belt drives of various kinds.

Insulation

The necessity for paying increased attention to quietness of operation resulted in one fan maker arranging careful sound insulation for his fans and their driving motors. Several makers announced new lines of sound insulating materials for supporting machines. Other interesting items included a metal foil pipe insulation, and the application of rockwool to standard pipe covering.

Other Items

Other new equipment items of interest announced during the year include an inside cooling tower; laminated packing for expansion joints; a pre-cast concrete conduit for underground piping, and hand tools and welding and cutting machines.

A carefully guided expansion joint was developed during the year, as was one with piston rings permitting packing under pressure.

Research Curtailed but Active in 1933

RESEARCH felt the depression worse this past year than during any previous one. This statement bears out common knowledge based on the greatly increased number of former research workers out of employment, the known reductions in appropriations to public research work, the smaller number of active industrial laboratories reported, loss of income by endowed institutions, and the reduced operating budget of the A.S.H.V.E. laboratory. There is no way of knowing how much the loss of funds amounts to or exactly how research is affected by it. There is no need of knowing with any degree of exactness. It is sufficient to know that in most cases research was dropped, postponed, or abandoned only as a last resort and when no means of support seemed possible. Even with the lessened activity the year's work is impressive in volume and has been productive of results.

New Research Facilities

Entrance of a number of established industrial companies into the production and sale of air conditioning equipment during the past year or two has caused them to enter into programs of research both to develop and strengthen their equipment and to engage in fact-finding in order to chart their own future courses. A few utility companies constructed what amounts to field laboratories in certain of their owned buildings in order to study phases of air conditioning. Strictly laboratory facilities were increased notably by a project for fan-testing and study at Lehigh University and by the completion of the John B. Pierce Laboratory of Hygiene at New Haven, Conn. The comprehensive plans for a research organization to cover the bituminous coal field had to be deferred after getting under way early in the year.

Foreign Research

Research in Germany which has been carried on in large volume for some years was greatly confused during the year by the new Nazi government. As much of the research was institutional and as the institutions have been upset by the new plans it is almost impossible to obtain a clear picture of where the German work stands.

The British Building Research Board which has facilities for studying the relation between radiant heat and the feeling of comfort continued its program but no official bulletins bearing on heating subjects appeared. Several papers resulting from this program appeared in British heating journals during the year, however. Among these are three by A. F. Dufton in the Journal of the Institution of Heating and Ventilating Engineers. One describes tests made on panel radiators, another gives the heating requirements of a house based on observations made several years ago, while another describes tests made to find the insulating value of a paper covered on both sides with aluminum foil, and which material is under consideration for use as wall material for a projected experimental room to be built at the Research Station maintained by the Board.

Research by Industrial Companies

Nearly all the industrial companies of prominence maintained their laboratories throughout the year. As nearly all of them are engaged in work of a private nature, statements of the projects are not possible. Most of these laboratories contracted their activities and their staffs sharply. The 1933 Bulletin of the National Research Council lists 23 companies in this field as maintaining laboratories during 1933 with a total of 120 men employed.

Among the active research projects are three by Detroit Edison Company. This company investigated the cooling of bedrooms by using an attic fan drawing in outside air. Several installations of this kind were made and operated through the summer. A residence which was equipped for ice-cooling in 1932 was again operated during this past summer in order to accumulate more data. A study of the control of inside temperature with reference to outside temperature was undertaken by installing several control devices of this kind and keeping operating records.

General Electric equipped a residence in Schenectady in order to gather data on air conditioning when applied to this kind of building.

Government Agencies

The heat transmission and radiator testing projects at the Bureau of Standards were continued into the year and at our last information are still active in spite of the reduced appropriation to the Bu-

reau which necessitated a drastic curtailment in some of its activities. The Bureau of Mines continued to furnish space and services to the A.S.H.V.E. laboratory at Pittsburgh.

Research Institutes

At the Mellon Institute the several Fellowships which have pursued research problems in subjects related to our field continued active. An Industrial Fellowship on heating has produced results which are expected to reach such a stage that they can be published soon. Those on air pollution, natural gas, petroleum, and anthracite continued. Smoke abatement, which has long received attention at the Institute, is still included in the active projects. During the year studies on the loss of heat from bare and covered copper pipes resulted in the publication of important results.

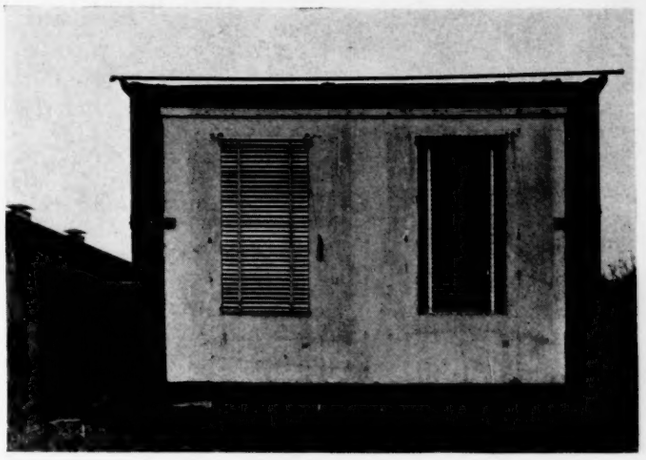
During the year two projects were started at Battelle Memorial Institute which are of interest to us. One is an attempt to correlate the smoking tendencies with other known properties of coal; the other sought to determine whether the tempering of coal as practiced on chain-grate stokers has a chemical or only a physical effect on combustion. Both projects were reported active at the year-end but results are not yet at hand.

Medical Aspects of Air Conditioning

For some years there has been a marked interest on the part of medical groups as to what applications could be made of conditioned air in treating certain diseases. A number of rather elaborate plants for investigating the subject have been built. Among these are rooms at Illinois, Johns Hopkins, and Harvard. During the year results from Harvard's work on ionization appeared and work continued on medical phases although not yet complete or fully reported. During the year, too, it was announced from Johns Hopkins that conditioned air had been used to advantage in the treatment of certain forms of hay fever. It is also announced that the Pierce Laboratory has worked during the past year on problems concerned with the measurement of heat losses due to radiation and convection. There, too, a study on the effect of heat and light rays on the reaction of the nose is nearly complete. This is a broad field and the research in it will no doubt provide increasingly interesting results in years to come.

Society Research

The technical societies have been faced with decreasing income throughout the past three years. Budgets have had to be cut. By the beginning of 1933 the only society left with a going research program of any size was the A.S.H.V.E. It started the year with a reduced budget and even this had to be cut during the following months. It became necessary to withdraw financial support from some of the college and university projects which had been under way in previous years. In some cases the institutions were able to arrange for support of their own and have thus been able to keep the projects active. The staff at the laboratory at Pittsburgh was reduced and so was the program there. Salary cuts were necessary.



Test house for studying effects of solar radiation, A.S.H.V.E. Research Laboratory

It is encouraging to note, though, that in spite of the difficulties encountered the research still survives and enters the new year with its essential organization unimpaired even though the financial outlook is still dark.

Early in the year the project on pipe sizes for steam heating systems which has been under way at the laboratory for some time was completed. Another phase of the general problem of the relation of indoor atmospheric conditions to the feeling of comfort and warmth was completed when the results of a study of the effect of wall surface temperatures were published last January.

Methods of measuring air change and air distribution have never been in a satisfactory state. A review of existing methods and a study of the indexes in use resulted in a publication on this subject in the middle of the year. It was suggested that humidity determinations may prove the best working index.

Garage ventilation has been under consideration for some time both at the laboratory and at the University of Kansas. A study by the laboratory staff of the carbon monoxide distribution in a one-story garage was completed during the year.

As a result of studies made during the year it is felt that it can be concluded that glass is not transparent to radiant heat from surfaces whose temperatures are below approximately 400°. This conclusion is based on studies of the absorption of radiant energy by glass from low temperature sources.

In connection with a study of factors affecting summer cooling of occupied space, it has developed that solar radiation through windows is a most important factor. In order to get more evidence on this subject the laboratory during the past summer undertook a study of the effect of window shades, awnings, venetian blinds, etc., in reducing solar radiation through windows into an air conditioned room. For the purpose of this study two small identical rooms with windows on the southern exposure were built and air conditioned at pre-determined temperatures throughout the summer months. Complete data were collected giving the rate of cooling required for each room with

the prevailing window shade condition and outside weather and sunshine. Sufficient data were collected to allocate avenues of heat gain resulting in the cooling load, including transmission through the walls, transmission through the glass by conduction, and transmission through the glass by direct radiation from the sun. Conclusive results are available as a result of this study showing effectiveness of different types of sun-radiation-arresting window appurtenances. A paper on the subject will be presented at the coming annual meeting.

In addition to the work at its own laboratory the society program includes that carried on cooperatively at a number of colleges and universities. During the year nine institutions were engaged in a total of 12 such projects. Two of these were definitely completed during the course of the year. Three more were either actually completed or substantially so. At the year-end it is probable that seven projects were still active at five institutions, viz.: Harvard, Illinois, Minnesota, Michigan College of Mines and Technology, and Case. The projects at Michigan Mines and Case were initiated during the year while the others are of longer standing. Further information on the nature and present condition of these various projects are included later under the heading of College and University Research.

Late in the year a pamphlet was issued listing the laboratories for research work in heating, ventilating, and air conditioning. This same pamphlet also carries a list of research projects.

College and University Research

Research conducted by the colleges and universities has traditionally been of the laboratory type. Of late, however, they have begun to look with more favor on collecting field and operating results. This kind of project showed an increase during the year.

These institutions were by no means exempt from the necessity of reducing budgets. As a result many projected pieces of research have had to be abandoned, deferred, or simply allowed to lapse into inactivity. This makes it difficult to get a reasonably exact picture of just how things stand at any given time. There is often a reluctance to report that a project is at a standstill or has been dropped even though such is the case.

In order to get together this information as it existed late in the year—or approximately at the year-end—questionnaires were sent to all these institutions. The list on pages 38 and 40 is the result. It is thought to show the real situation late in 1933. So far as possible strictly undergraduate student projects have been omitted because of space limitations.

Research at Colleges and Universities

A check list of projects active at year-end, in progress, or completed during 1933

Steam and Hot Water Heating

ROOM Heating with Direct Radiators. At University of Illinois. Sponsored by the University and the A.S.H.V.E. cooperatively. Directed by Professors A. C. Willard and A. P. Kratz. Continuing project of several years standing. Condition:—active.

Heat Distribution by Convectors (Concealed Radiators) in a Cold-Wall Test Room, Effect of Temperature at the Heating Source. At and sponsored by the Case School of Applied Science. Directed by Professors F. H. Vose and G. L. Tuve. Condition:—active. No published results as yet.

Heat Emission of Concealed Hot Water Radiators at Different Mean Temperatures. At and sponsored by the University of Toronto. Directed by Prof. E. A. Allcut. Condition:—active, but curtailed.

Comparison of Heating with Direct Radiation and with Unit Heaters. At the University of Wisconsin. Sponsored by the University and the A.S.H.V.E. cooperatively. Directed by Professors G. L. Larson, D. W. Nelson and J. W. James. Condition:—active during the heating season 1933-1934.

Economy of Lowering Temperatures During Inoccupancy and the Resulting Peak Loads on the Vacuum Pump. At the University of Wisconsin. Sponsored by the University and the A.S.H.V.E. cooperatively. Condition:—active during the heating season 1933-1934.

Regulation of Heat Supply by Zone Control, by Orifices and by Outside Temperatures. At the University of Wisconsin. Sponsored by the University and the A.S.H.V.E. cooperatively. Directed by Professors G. L. Larson and D. W. Nelson. Condition:—active during the heating season 1933-1934.

Economy of Carrying Reduced Temperatures at Night in Oil-Heated Residences. At and sponsored by the University of Wisconsin. Directed by Professors G. L. Larson and D. W. Nelson. Condition:—active during the heating season 1933-1934.

Performance of Oil Burners and Oil-Fired Heating Boilers. At Yale University. Sponsored by the University and A.S.H.V.E. cooperatively. Directed by Prof. L. E. Seeley. Condition:—completed.

Relation Between Condensation in Returns of Steam Heating Systems and Corrosion. Conducted at the Michigan School of Mines and Technology. Sponsored by the School and the A.S.H.V.E. cooperatively. Condition:—started during year, still in progress; no results reported.

Characteristics of Unit Heaters Using Super-Heated Steam Compared to their Performance when Using Saturated Steam. At Pennsylvania State College. Sponsored by Mechanical Engineering Department. Directed by R. D. Fellows. Condition:—in progress.

Economy of Flexible Joint Cast-Iron Pipe for Underground Condensate Return Lines. At and sponsored by the University of Tennessee. Directed by Prof. W. R. Woolrich. Condition:—active; no results reported.

Requirements, Demands and Practices in Heating College Buildings. At and sponsored by Lafayette College. Directed by Prof. E. N. Fernald. Condition: started during the year; no results reported.

Survey of Heating Costs in Various Types of Buildings. At and sponsored by the University of Wisconsin. Directed by Professors G. L. Larson and D. W. Nelson. Condition:—in progress during 1933-1934.

Effect of Control Methods on Operating Efficiency of Conversion Gas Burners. At and sponsored by the University of Arkansas, under the direction of L. C. Price. Condition:—completed.

Investigation of Draft Hoods for Gas-Boilers and Gas Conversion Boilers. At and sponsored by the University of Arkansas. Directed by L. C. Price. Condition:—started during the year, in progress.

Heat Transfer

Heat Losses Through Various Types of Building Construction. At the University of Minnesota. Sponsored cooperatively by the University and the A.S.H.-V.E. Directed by Prof. F. B. Rowley. Condition:—completed during the year.

Heat Transmission Through Walls of Various Materials. At the University of Toronto. Sponsored by the University. Directed by Prof. R. W. Angus. Condition:—active, but curtailed.

Transmission of Heat Through Various Thicknesses of Materials (Hot Plate Apparatus). At and sponsored by the University of Toronto. Directed by Professors A. E. Allcott and R. W. Angus. Condition:—active, but curtailed.

Heat Transfer Coefficients of Insulating Materials with Variable Moisture Content. At and sponsored by The Pennsylvania State College. Directed by Professors F. G. Hechler and E. R. Queer. Condition:—active, in progress.

Periodic Heat Flow (Theoretical Development). At and sponsored by the University of California at Berkeley. A thesis project, directed by H. A. Johnson. Condition:—in progress.

Film Conductances for Heat Flow through Tubes to Air-Water Vapor Mixture, Flow Normal to Tubes, Tube Temperature Less Than Mixture Temperature. At and sponsored by the University of California at Berkeley, and directed by G. R. MacPherson. Condition:—in progress.

A Study of Heat Transmission and Heat Loss from the Cylinder to the Air. At and sponsored by the University of Toronto. Directed by E. Hymann, a research student. Condition:—in progress.

The Effect of Humidity on Heat Transfer. At and sponsored by the University of Tennessee. Directed by Prof. W. R. Woolrich. Condition:—completed during the year.

Heat Transfer of Finned Tubing with Forced Air Circulation. At Case School of Applied Science. Sponsored cooperatively by Case and the A.S.H.V.E. Condition:—project started during the year, still under way; results not yet reported.

Heat Transfer Coefficients for Fin Tube Cooling Units. At Georgia School of Technology. Sponsored by the School and commercial companies. Under the direction of Mechanical Engineering Department. Condition:—in progress, and expected to be finished by June, 1934.

Effect of Air-Stream Turbulence on Heat Transfer with Forced Air Circulation (Blast Coils). At and sponsored by Case School of Applied Science. Condition:—project started during the year; no reported results as yet.

Development of a Simple Instrument for Measuring Radiant Heat. At and sponsored by Harvard University. Condition:—active; no results reported to date.

Surface Film Heat Transfer Coefficients for Various Boiling Refrigerants. At and sponsored by The Pennsylvania State College. Directed by Professors F. C. Stewart, F. G. Hechler and E. R. Queer. An extensive project with experimental work, largely by graduate assistants for post-graduate degrees.

Heat Transmission Through a Thin Steam Heated Copper Duct to Air at Various Velocities. At and sponsored by Stanford University. A thesis, by Max Marx, under the direction of Mr. Washington. Condition:—apparatus partly set up.

Experimental Determination of Probable Errors of Humidity by Wet and Dry Bulb Thermometers. At and sponsored by The Pennsylvania State College. Directed by Mechanical Engineering Department and Experiment Station. A graduate thesis. Condition:—completed.

Stability Limits of Natural Gas Flames. At and sponsored by the University of California at Berkeley. Directed by Hugh H. Hyde. A thesis project. Condition:—in progress.

Ventilation and Air Flow

Minimum Air Requirements for Ventilating and Air Conditioning. At Harvard University. Sponsored by

A.S.H.V.E. Directed by Prof. C. P. Yaglou. Condition:—in progress during 1933.

Study of Dust Removal and Control Equipment. At University of Minnesota. Sponsored by University and A.S.H.V.E. cooperatively. Condition:—active; no results reported as yet.

Air Flow Through Registers and Grilles. At Armour Institute of Technology. Sponsored by the Institute, A.S.H.V.E., Ventilating Contractors Employers Association of Chicago. Directed by Prof. L. E. Davies. Condition:—completed.

Infiltration of Air Into Buildings. At the University of Wisconsin. Sponsored by the University and A.S.H.V.E. cooperatively. Directed by Professors G. L. Larson and D. W. Nelson. Condition:—inactive at present.

Coefficients of Friction in Large and Small Ducts as Affected by Wall Roughness (Application to Chimney Design). At and sponsored by Johns Hopkins University. Directed by Prof. J. C. Smallwood. Condition:—completed, results showed agreement with established values for smooth ducts; not published.

Friction Factor and Non-Isothermal Low Velocity Flow Through Tubes (Theoretical Development). At the University of California, Berkeley. Sponsored by the University. Directed by Prof. V. H. Cherry. A thesis project. Condition:—in progress during 1933.

Performance of Propeller Fans. At Ohio State University. Sponsored by the Engineering Experiment Station. Directed by Prof. A. I. Brown. Condition:—completed; results in bulletin of Experiment Station.

Methods of Fan Testing. At and sponsored by Ohio State University. A thesis project. Directed by A. G. Allen. Condition:—in progress during 1933.

Study of Proposed Ventilating System for New Chicago Subway. At the University of Illinois. Sponsored by the University and Bureau of Subways of the City of Chicago. Directed by Professors Willard, Severns and Bradley. Condition:—preliminary work completed.

Effect of Sudden and Gradual Changes in Cross-Section and the Pressure Loss in Air Ducts. At the University of Illinois. Sponsored by Engineering Experiment Station. Directed by Prof. A. P. Kratz. A graduate school thesis. Condition:—completed; results not published.

Air Conditioning

Artificially Ionized Air, Physiological and Bichemical Effects. At and sponsored by Harvard University. Directed by Prof. C. P. Yaglou. Condition:—active.

Methods of Artificial Ionization. At and sponsored by Harvard University. Directed by Prof. C. P. Yaglou. Condition:—active, in progress.

Physiological Effects of Atmospheric Ionization. At and sponsored by Harvard University. A thesis project for postgraduate degrees. Condition:—in progress; partial results reported during the year.

Daily and Seasonal Changes in Atmospheric Ionization, Outdoors and Indoors, 1930-1933. At Harvard University. Sponsored by Harvard. Work carried out cooperatively with A.S.H.V.E. Condition:—active during the year; results ready for reporting.

Influence of Atmospheric Conditions on the Growth and Development of Premature Infants. At Harvard University. Directed by Dr. K. Blackfour and Prof. C. P. Yaglou. Condition:—report in press.

Treatment of Disease with Ionized Air. At and sponsored by Harvard. Directed by Dr. J. Wilson. Condition:—in progress.

Refrigeration Requirements in Domestic Summer Cooling. At the University of Illinois. Sponsored by the Engineering Experiment Station, A.S.H.V.E., National Warm Air Heating and Air Conditioning Association, National Association of Ice Industries, Utilities Research Commission, and industrial companies. Directed by Professors A. C. Willard and A. P. Kratz. Condition:—active during 1933.

Well Water as a Cooling Unit for Domestic Air Conditioning. At Kansas State College. Sponsored by Engineering Experiment Station. Condition:—active during 1933.

Tests on Domestic Air Conditioning Units. At and sponsored by Stanford University. A post-graduate project. Directed by Kenneth N. Brown. Condition:—project just starting.

Test of a Summer Air Conditioning Plant Using Silica Gel in a Restaurant. At and sponsored by the Polytechnic Institute of Brooklyn. Directed by Prof. E. F. Church, Jr. Condition:—active during 1933.

Methods of Determining the Effect of Atmospheric Conditions on the Behavior of Workers in Industry. At and sponsored by Ohio State University. A post-graduate thesis project. Directed by J. A. Sullivan. Condition:—in progress during 1933.

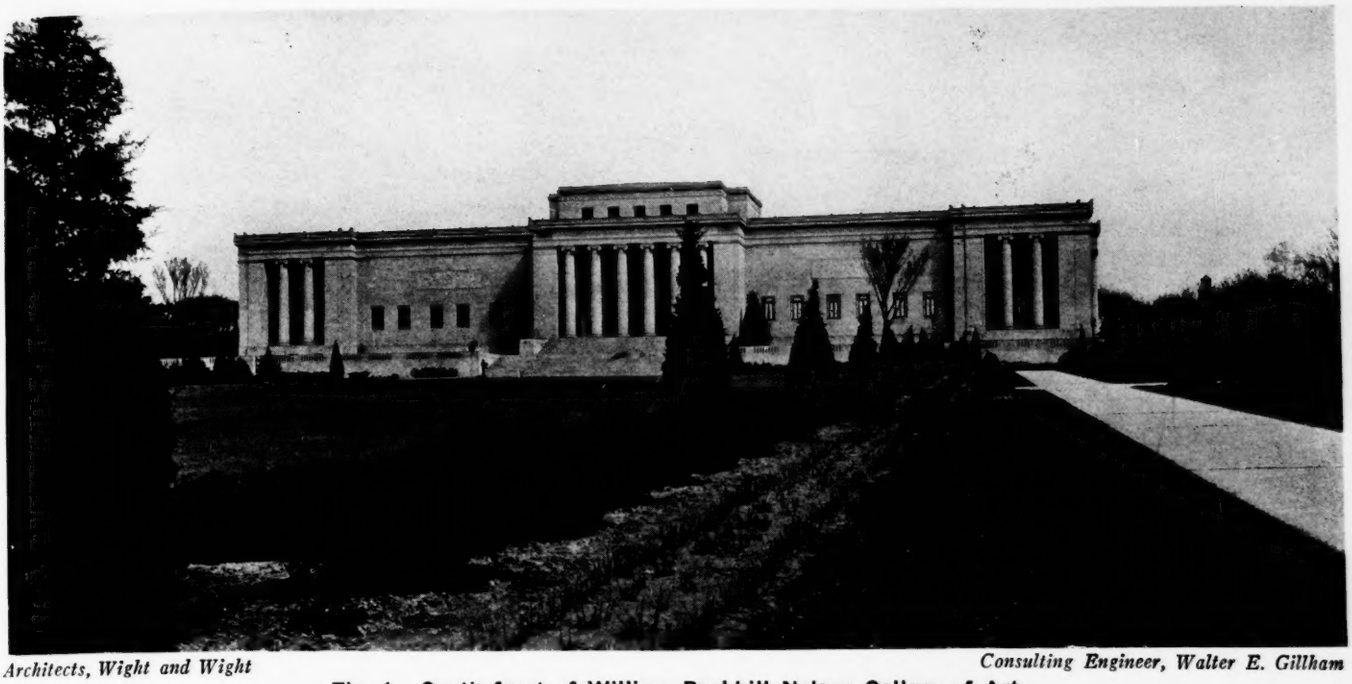
Modification and Test of a Small Office Air Conditioning and Heating Unit. At and sponsored by Polytechnic Institute of Brooklyn. Directed by Prof. E. F. Church, Jr. Condition:—in progress during 1933.

Investigation of Non-recirculating Air Washer. At the University of Illinois. Sponsored by the Engineering Experiment Station. Directed by Prof. A. P. Kratz. Graduate School thesis. Condition:—completed; unpublished.

Miscellaneous

Residence Heating with Warm Air, both Gravity and Forced Circulation. At the University of Illinois. Sponsored by Engineering Experiment Station and National Warm Air Heating and Air Conditioning Association. Condition:—active during 1933; continuation of a long-standing project.

Efficiency and Design of Fireplaces Adapted to Southern Homes. At the University of Tennessee. Sponsored by the University and the Tennessee Valley Authority. Directed by Prof. W. R. Woolrich. Condition:—in progress during 1933.



Architects, Wight and Wight *Consulting Engineer, Walter E. Gillham*

Fig. 1. South front of William Rockhill Nelson Gallery of Art

Kansas City Art Museum Presents Special Problems in Heating and Ventilating

By WALTER E. GILLHAM†

WHEN William Rockhill Nelson, founder, editor, and owner of the *Kansas City Star* died he left in trust an estate valued between ten and twelve million dollars to Kansas City, Mo., the income from which was to be used for the purchase of objects of art. His will specified that an artist must be dead at least 30 years before his pictures could be purchased, which meant that only proven works of art were to be purchased.

To house these fine paintings and art objects, a building had to be erected. For this purpose the wills of Mrs. Nelson, Mrs. Laura Nelson Kirkwood, a daughter and her husband left a substantial sum, to which was added a sum of money left in trust by Mrs. Mary Atkins for a Museum of Fine Arts, and money left for the same purpose in the estate of Frank Rozelle. The total of these bequests amounted to almost three million dollars with which has been erected the magnificent building know as the William Rockhill Nelson Gallery of Art and Atkins Museum of Fine Arts.

The building, designed by Wight and Wight, Kansas City architects, is constructed of Bedford stone and is lined throughout with 1-in. thick corkboard. It is approximately 384 ft. × 192 ft. and stands approximately 64 ft. above grade, consisting of ground, first, and second floors. The ground floor is devoted to storage space for fine paintings and bric-a-brac, and is ventilated in the same manner as the galleries in order to preserve the paintings stored there. The central portion of the ground floor is where the major part of the supply and exhaust fan equipment is located and occupies a space 80 ft. × 92 ft. × 14 ft. A large auditorium and general offices are also located on this floor. The first and second floors are devoted almost exclusively to galleries for hanging of pictures.

Owing to the separate trust funds combined to erect

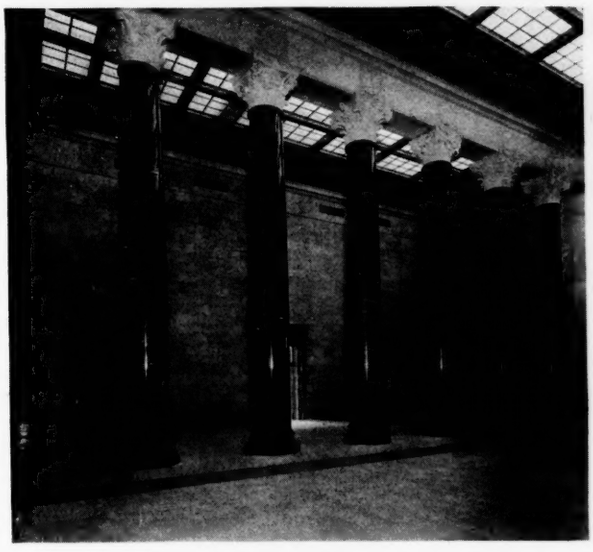


Fig. 2. Hall of Columns showing supply and exhaust grilles

†Consulting Engineer, Kansas City, Mo.

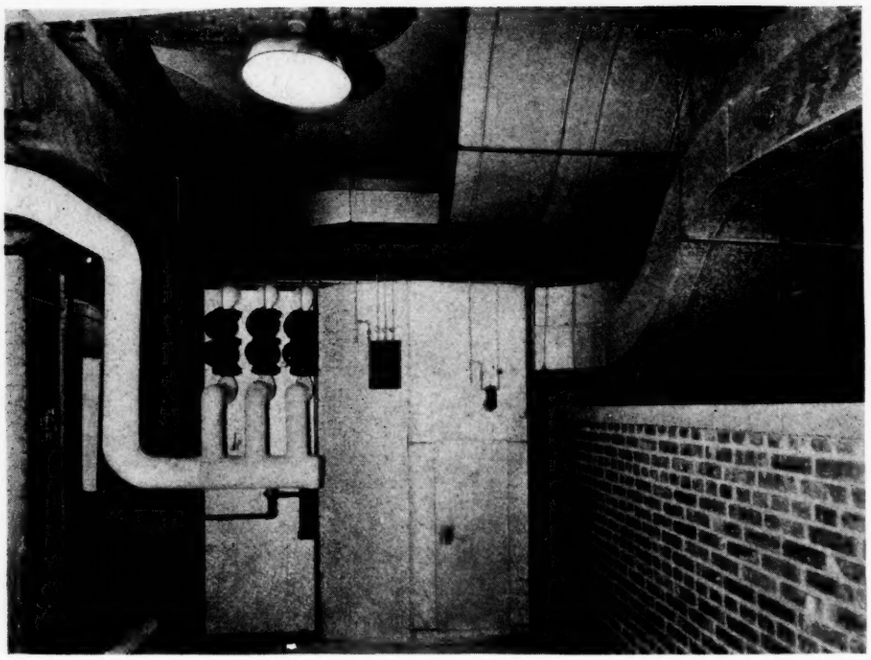


Fig. 3. Coil control valves, humidistats, and air filters

the building, it was found necessary to separate the cost of the various parts of the building so that each could be charged to its respective fund—either Nelson or Atkins—and it was necessary to take this condition into account when preparing the drawings for the mechanical work as the maintenance and operating costs must also be separate and each charged to its respective fund.

Elimination of radiators in the galleries and the decision to use a steam blast system of heating and ventilation was to eliminate all danger of ruining valuable paintings or destroying priceless objects of art by leaky radiation or the breaking of a steam pipe and the flooding of a gallery with steam. The placing of the boiler plant entirely outside the building was to remove all possible danger from a boiler explosion, remote though it may be. The boiler plant was placed under ground to remove an unsightly boiler house from the vicinity of this beautiful structure.

The galleries are not air conditioned for comfort, but every precaution was taken to provide the proper air conditions to preserve the valuable paintings hung there or in storage, and with this in view, careful selection was made in the type of air filter used as dust and dirt will cause rapid deterioration of paintings. The multi-panel automatic oil filter was selected, and all air, both recirculated and fresh, is filtered before entering the galleries.

The rapid deterioration of canvas, books, and tapestries is due to the quick change from summer to winter conditions in the humidity or amount of moisture content of the air. This is guarded against by the installation of steam humidifying coils in connection with each supply fan. These are provided in connection with storage rooms as well as galleries. The coils are controlled automatically by hygrostats which can be set to regulate the percentage of relative humidity desired.

Boiler Plant

The boiler plant which furnishes steam to heat the building and space large enough to accommodate a future power plant, 92 ft. × 56 ft. in plan and 26 ft. in height, is located entirely apart from the main building about 3 ft. 6 in. below ground with blue grass, small shrubs and flowers planted overhead. The smoke stack and a small entrance are the only part of the boiler house extending above ground.

In the boiler house are located three 200-hp. firebox-type boilers, vacuum and boiler feed pumps. The boilers are provided with combination gas and oil burners. It was highly desirable to eliminate soot and smoke around the building or grounds and with this in view combination oil and gas burners were selected, and proved to be highly efficient with either fuel. The burners are provided with a high-pressure motor-driven blower, and the air for combustion easily regulated and

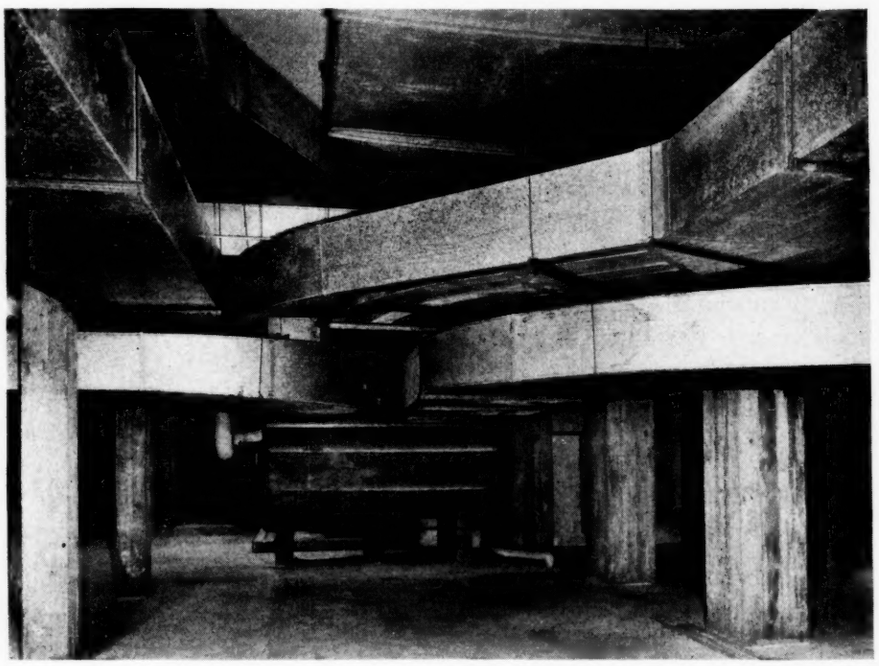
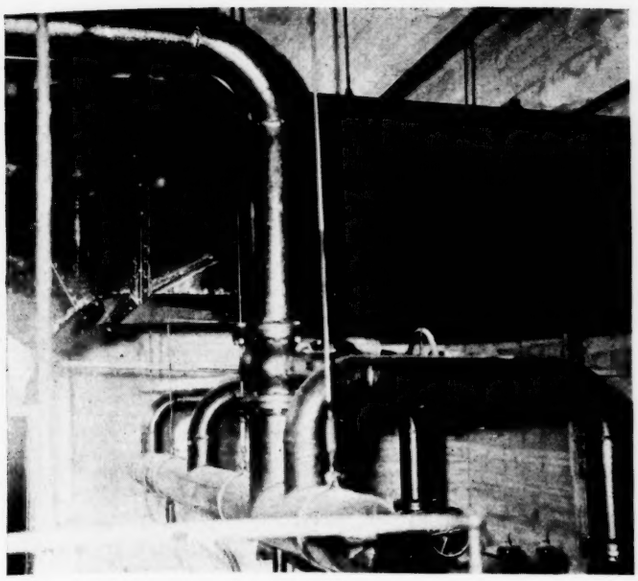


Fig. 4. Main fan room showing multiplicity of ventilating ducts



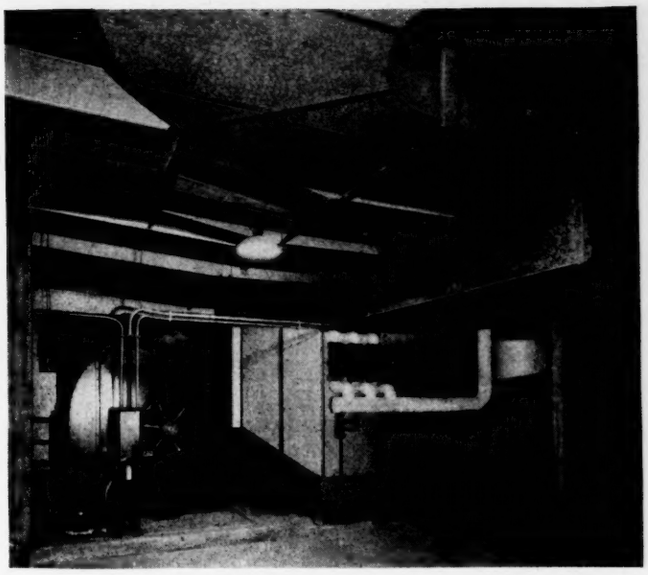


Fig. 5. (Left) Welded boiler headers. Fig. 6. (Right) Each fan and motor rests on a sound-insulated foundation

controlled and there has been no trouble from soot or smoke.

Two oil storage tanks 8 ft. × 32 ft. are also buried in the ground adjacent to the boiler house. The boiler house is connected to the main building by a large tunnel and man-sized tunnels run under the ground floor entirely around the outside walls of the building with various cross tunnels to carry steam supply and vacuum return piping. Where it was found necessary to bury steam and return piping under ground, cast-iron pipe was used for sizes 1½ in. and larger and 85% red brass for smaller sizes.

Ventilation and Heating

There is a total of 22 supply and exhaust fans installed in the building, ranging in capacity from 51,200 c.f.m. down to 1,500 c.f.m., not including various unit heaters, with a total capacity of more than 460,000 c.f.m. Each fan motor is controlled from a central control panel with indicating lights located in the main fan room on the ground floor.

Quietness was particularly essential in this building and for this reason slow-speed-type fans were used throughout, with motors designed and selected for quiet operation. Each fan and motor rests on specially constructed resilient, sound-insulating foundations consisting of a concrete slab floating a 3 in. thick layer of waterproofed cork with cork curbs entirely around the floating slab with a concrete curb around the whole, raised to the level of the floating slab. Fans and motors are mounted on the floating slab. This type of foundation has proven highly satisfactory as a sound deadener. Canvas connections were provided between all fan inlets and outlets and galvanized iron ductwork to prevent sound or vibration travel. Practically all fan units are driven through V-belt drives.

The ventilation and heating of the building is broken up or divided into various systems, first because of the prodigious size it would be most unwieldy if handled as one unit and, second, because of the separate funds used in erecting the building.

The central portion of the first floor, known as Tapestry Hall or Hall of Columns, is a room 88 ft. × 68 ft. with a 40-ft. ceiling and the two main entrances of the building — north and south — enter this room. The principal features of the room are 12 black marble columns in two rows through the center of the room. This room is ventilated and heated by a supply and exhaust fan system, each fan having a capacity of about 26,400 c.f.m.

The galleries on the north and south sides of the second floor of the Nelson Gallery are ventilated by two separate supply and exhaust fan systems. These units handle about 24,000 c.f.m. each and are located on the second floor.

The Auditorium is located on the ground floor and belongs to the Atkins portion of the building. It has a seating capacity of about 600 and has separate supply and exhaust fans with a capacity of about 16,500 c.f.m. These fans are located in the main fan room.

The Atkins Court, consisting of a group of seven galleries on the first floor and one large and three small galleries on the second floor, is located directly above the Auditorium in the central part of the east end of the building and has a separate supply and exhaust fan system with a capacity of 26,400 c.f.m. These fans are located above the second floor.

The main portion of the Atkins part of the building, which is the extreme east wing both first and second consisting of a large group of galleries, is heated and ventilated by a supply and exhaust fan system, the units being located in the central fan chamber of the ground floor. These units have a capacity of about 37,600 c.f.m.

There are a number of other supply and exhaust fans of smaller size in the building to ventilate toilet rooms, kitchen, transformer, and storage rooms. In the fresh air intake of each supply fan and the exhaust to atmosphere of each exhaust fan was located a louver damper controlled by an electro-pneumatic or magnetic switch on motor feeders, so arranged that when the motor was started the switch would be energized and

the louver damper opened, thus preventing back-drafts in the building when the fans were not in operation.

In the construction of galvanized iron ductwork 400,000 lb. of galvanized sheets and 50,000 lb. of angle iron were used.

Each supply fan unit is provided with cast-iron blast coils to temper and reheat the air and a multi-panel automatic air filter to clean and condition the air. Humidifiers are provided in each supply fan chamber and the percentage of humidity supplied is controlled by a hygrostat. The amount of air to be recirculated or discharged from the building is regulated by means of a thermostat located in the fresh air chamber arranged to control fresh air, return air, and exhaust air dampers. Thus, in the summertime all of the air supply may be brought in from outside the building and in the wintertime as little as 10% of fresh air may be supplied, depending on the temperature of the outside air and the point at which the thermostat is set.

The entire building with the exception of the vestibules, toilet rooms, offices, and a few special rooms are heated and ventilated throughout by supply and exhaust system of fan ventilation. Separate or individual ducts are run to each register opening and the temperature of the air in each room is controlled by a thermostat in the room operating mixing dampers at the fan chamber.

Insulation

After a careful study it was decided to eliminate all skylights and windows and use only artificial light for the galleries. This was for a two-fold purpose: skylights and windows when arranged to give proper lighting of pictures are expensive to construct and the cost of upkeep is a momentous one. Then, too, placing expensive paintings under a skylight where a hail storm or heavy rain might develop a leak was a hazard not to be considered. By the elimination of the skylights and windows wherever possible, and the lining of the outside walls and roof with corkboard, a tremendous saving in heat loss was accomplished in the wintertime and the rooms are cooler in the summertime. 129,228 sq. ft. of 1-in. thick corkboard were installed at an expense of about $28,000. This expense, however, was easily offset by the saving in cost of constructing the skylights and windows. It was estimated that the cost of upkeep of skylights would be high, and there is no upkeep cost for the cork.

The large banks of artificial lights are located above a glass ceiling and the heat generated by them is carried off by passing exhaust air from the gallery over these lamps, thus utilizing the heat generated by the lamps before recirculating it or discharging same out of the building.

The use of insulation resulted in a saving in the first cost of the heating system of about 10,000 sq. ft. of direct radiation, which at a reasonable estimate would be about $15,000. Savings in operating cost of heating per year will amount to between $3,500 and $4.000.

Contracts

The heating and ventilating equipment was let in three separate contracts:

1. *Heating,* in which was included the boiler plant with all steam and return piping, direct radiation, cast-iron vento stacks for ventilation, insulation, traps, valves, etc. Contract let to MacMahon Plumbing and Heating Company.

2. *Ventilating,* in which was included all galvanized iron ductwork, grilles, registers, diffusers, supply and exhaust fans, motors, etc. Contract let to Kornbrodt Kornice Kompany.

3. *Automatic Temperature Regulation,* with all dampers, thermostats, valves, pneumatic switches, humidifiers, humidistats, etc. Contract let to Johnson Service Company.

The total amount of these contracts was about $200,000.

British Ventilating Authority Discusses Popular Fallacies

MANY popular beliefs regarding fresh air and health were criticized by Prof. Sir Leonard Hill, British heating and ventilating authority, in his presidential address to the Sanitary Inspectors Association Conference, recently held at Clacton, England.

"We now know," declared Sir Leonard, "that the chill felt before the heat of fever is not the cause of the fever, but the shivering stage which ushers an infection. And yet to this day children are mistakenly kept indoors in air polluted with microbes for fear of catching cold outside.

"Most people still believe in the danger of a draft, and 50 years ago Buchan in his famous book on ventilation wrote: 'A draft of cold may kill like a sword almost instantly.' Many experiments have, however, recently been made of standing naked in drafts after hot baths and of blowing cold air on the naked body of healthy men, and no evidence has been obtained that colds and pneumonia are so caused.

"The stripping off of most of the heavy Victorian-age clothing by women has certainly resulted in their improved health and vigor."

Sir Leonard declared that schools as at present built and run in many communities are too often places which improve the manners and sharpen the mind, but weaken health and vigor.

"When an epidemic is going round," he continued, "schools have to be closed. They should be gently heated by panels in ceilings and given plenty of open air, and the children should play a game every half-hour to keep them warm and lively. Eyes water and noses run on a cold day not because of a cold has been caught, but as a natural response to the breathing of cold air."

Abstracts . . .

Reviews and Summaries of. . . . Current Papers, Books and Pamphlets

Economical Heating Practice

Of interest to building owners and managers is a brief treatise on the economics of heating, prepared by the Commercial Relations Committee of the National District Heating Association from material presented at the Association's annual convention, held at Chicago last summer. The booklet brings up-to-date the information contained in the Association's official pamphlet, "Principles and Methods of Heat Saving," and contains the latest practical methods for eliminating waste in the heating of buildings.

Included among the topics covered are: heat losses from buildings, ventilation, short-hour heating, temperature control, methods of effecting savings, and convenience and ease of operation.

[*Title: "Principles of Economical Heating," National District Heating Association, 603 Broadway, Greenville, Ohio. Paper-bound; 48 pages; 25 cents per copy in quantities of 10 or less, reduced price for quantity lots.*]

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Temperature Gradients in Large Heated Space

The authors report a series of observations conducted in the field house of the University of Wisconsin, Madison, to determine the temperatures at the various levels from the floor to the ceiling during the heating season, both with and without mechanical ventilation. The interior of the main part of the structure is 193 ft. wide, 227 ft. long, and 97 ft. high. Exterior walls are of sandstone, backed with poured concrete, and the roof consists of 2-in. planking with 1 in. of cork and tile. The enclosure is heated indirectly by six coils of copper-finned tubing, three of which are located in each of the twin fan chambers. The air discharge is from a trunk duct line under the lower balcony, and each outlet is equipped with a finned copper tube heater. The air supply can be taken directly from the outside or may be entirely or partially recirculated.

Five charts show detailed records of temperatures at heights of 5 ft., 15 ft., 25 ft., 45 ft., 65 ft., 75 ft., 85 ft., and 95 ft. above the floor level, the relative humidity, and the hourly steam consumption, as observed at ½-hr. intervals during occupancy of the building by basketball spectators. Each series of observations was made under different outside weather conditions, and under different operating conditions. A sixth chart shows temperature plotted against height above the floor level for three cold days with the building unoccupied.

A temperature gradient of about ¾° per ft. was found for the first 15 ft. on days when the outside temperature was near 0°, with gravity circulation. Under these conditions, the gradient was about 1/10° for each foot above the 15-ft. level. On a day when the outside temperature was —15° it was found that operation of the fans reduced the gradient from 22° to 7° between floor and roof with the building unoccupied.

[*Title: "Temperature Gradient Observations in a Large Heated Space," by G. L. Larson, D. W. Nelson, and O. C. Cromer, all of the engineering faculty, University of Wisconsin. Paper presented at semi-annual meeting, A.S.H.V.E., Detroit, June, 1933; approximately 7000 words; charts; diagrams.*]

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Water for Air Conditioning

This paper takes up in some detail the thermodynamic considerations necessary in the handling of condensing water problems in refrigerating systems as applied to air conditioning. The author supplies data and information to answer the question of whether it is cheaper to increase the horsepower at the prevailing power cost or whether it is economically feasible to buy additional water and save the cost of additional power; or whether a colder source of water can be provided to cut the power costs.

The first part of the paper is devoted to a development of a series of theoretical curves showing relationships between capacity, horsepower, and condensing water temperature, and also the quantities of condenser water required under various conditions of suction and head temperatures for the various refrigerants. These curves, as plotted, are purely theoretical, since no account is taken of volumetric or mechanical efficiencies of the apparatus, but the results are suitable for comparisons of the requirements of the systems considered.

A discussion of the considerations to be met in cooling tower design is then taken up. The author here presents an example to illustrate how the temperature and humidity of the air affect the quantity of water to be handled.

Heating by means of the reversed refrigeration cycle is then described by the author. In this connection it is pointed out that the temperature in the evaporator must be at least 10° lower than that of the outside air in order that there will be sufficient differential, and the condensing temperature should not be less than 100° so that heat will be transferred from the refrigerant to the air in the room. In localities with climates similar to that found in New York, where the design temperature for heating is 10°, this limitation requires that the evaporator temperature be 0°, and makes it necessary to install a much larger refrigerating machine for heating purposes than would be required to carry the cooling load in summer. A refrigerating machine of suitable capacity to carry the cooling load in New York will be sufficiently large to carry the heating load when the outside temperature is 38.5°, and to

carry the heating load when the temperature is near the design temperature, a much larger machine will be needed.

[*Title: "Water in Refrigeration," by Walter L. Fleisher. Paper presented at annual meeting, A.S.R.E., New York, December,* 1933; *approximately* 5000 *words.*]

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Commercial Air Conditioning Applications

This paper discusses the application of unit air conditioners to heating and cooling restaurants, offices, and stores, and describes and classifies the various types of equipment available for this purpose. The author points out the advantages of this type of conditioner for certain classes of service.

Location and control of unit air conditioners is taken up in the paper, the author listing the considerations to be met in selecting the capacity and position of the apparatus. It is pointed out that careful attention must be given to the location of auxiliary and related equipment, such as controls, condensers, compressors, and boilers.

[*Title: "Commercial Air Conditioning," by W. C. Goodwin, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.; paper presented at annual meeting, A.S.R.E., New York, December,* 1933; *approximately* 3500 *words.*]

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Industrial Heat Transfer

This book is a translation of the German text by Doctor Schack, which can rightly be considered an original work in English, so admirably the translators succeeded in the difficult task of putting technical German into easily-read technical English, and converting the metric to the English system of units. The manner in which the book has been completely made over has made it of the greatest benefit to the practicing engineer.

The particular field covered by the subject matter necessarily requires the utilization of considerable mathematics. Doctor Schack has given the development of equations particular emphasis, and at the same time has suceeded in placing them in the text in their least complex forms. Contrary to usual procedure, the theory of similarity has been largely avoided, and empirical equations have been adopted as far as possible without impairing accuracy.

The translators have used a system of marking the most important equations with a star. The nomenclature and system of symbols which has been adopted and endorsed by the American Standards Association has also been applied insofar as possible. Equations having limited use, or which may be superseded by more accurate equations in the later sections of the book, carry an explanatory note, which enables the user to arrive at the best solution of his problem with the least loss of time.

The first two sections treat on the three modes of heat transfer. The variables affecting each are independently considered in a manner which makes easy reading. The next two sections deal with methods of computation for heat exchangers and industrial furnaces, after which follows a section on the relation between heat transmission and pressure drop. The section devoted to practical examples in heat transfer, as well as those compiling the more important equations and physical constants applicable, are of particular interest to the practicing engineer as well as to the student. Many references are cited, which should be useful for detailed study by the student. Due to the fact that the translators have included references to the most recent work on pertinent subjects, as well as some new and previously unpublished data by Doctor Schack, it can truly be said to be up-to-date.—*Edgar C. Rack.*

[*Title: "Industrial Heat Transfer," by Alfred Schack, Dr.-Ing.; translated from the German by Hans Goldschmidt, Dr.-Ing., and Everett P. Partridge, Ph. D.; published by John Wiley and Sons, Inc., New York;* 371 *pages;* 6 *in.* × 9 *in.; illustrated; price,* $5.]

●

Heat Transfer Rates in Refrigerating and Air Cooling Apparatus

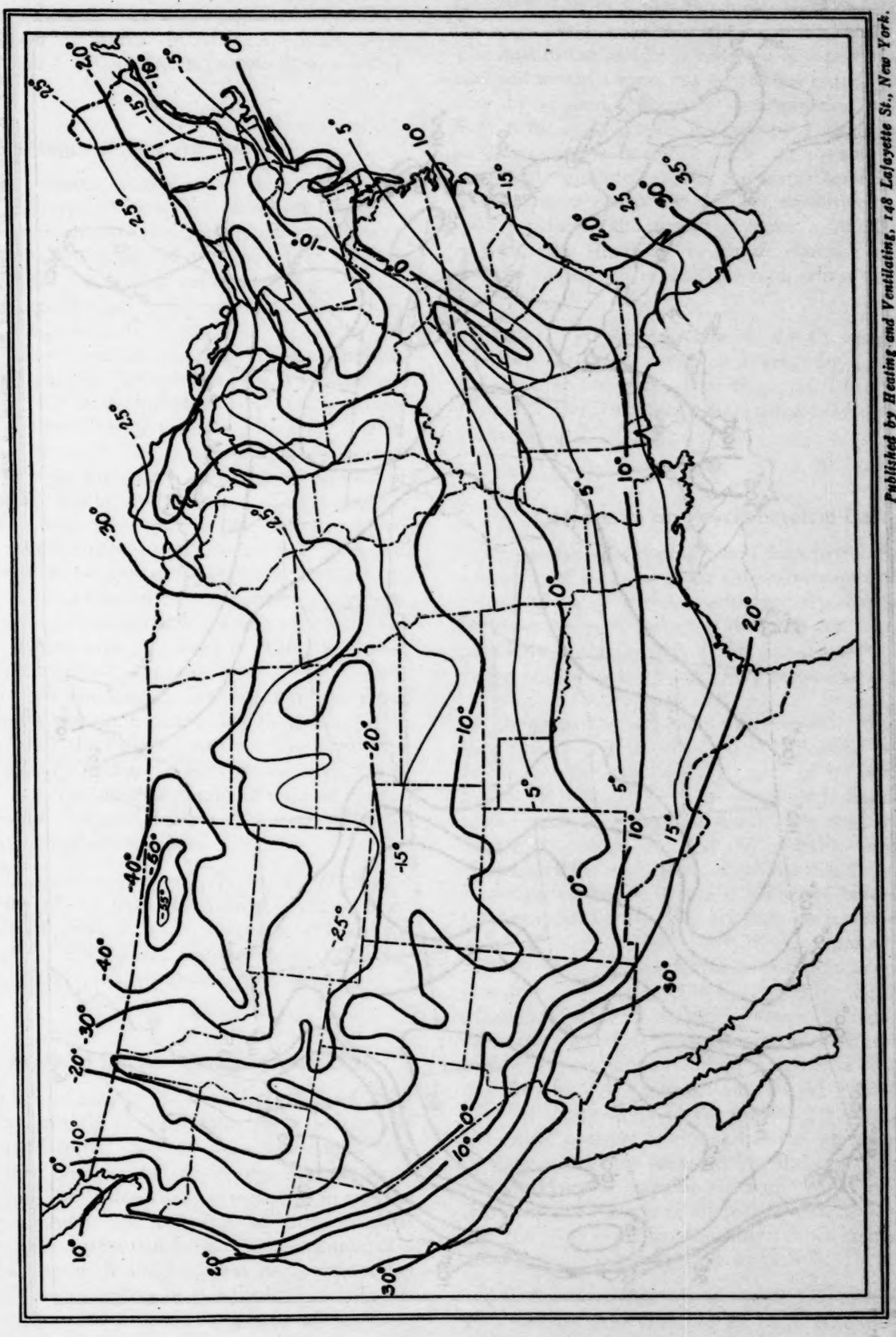
This paper summarizes and discusses latest accepted theory and practice for the solution of problems relating to the transfer of heat by free and forced convection, evaporation, and condensation, as encountered in refrigerating and air cooling equipment. Although conduction and radiation are frequently factors in such problems, the authors have not included them in the discussion because the data are so readily available.

Simple empirical formulas for the film coefficient for free convection computations are given for vertical plane surfaces, vertical or horizontal pipes in still air, and bodies submerged in unagitated water. A series of curves shows the relation between heat transfer coefficients for air at 70° at one atmosphere, and the linear velocity of the air in feet per second, and another series shows similar relationships when finned tubes are used. A table provides correction factors for tubes of various diameters.

A considerable portion of the paper is devoted to a discussion of the effects of dehumidification upon the convection coefficients for air. In this connection, curves are presented showing the effects of variations in temperature over the surface of the fin on the rate of evaporation and the heat transfer coefficients, and formulas for determining the effects of the humidity factor upon the transfer coefficient are discussed. The results indicate that under some conditions of temperature and humidity the heat transfer coefficient may be more than double the coefficient for sensible heat transfer alone.

Available information on heat transfer from metallic surfaces to boiling liquids is stated to be less satisfactory than that on other heat transfer processes. The authors present curves to show the variation of evaporation coefficients for representative refrigerants for various temperature differences. The paper concludes with a discussion of the process of condensation as it applies to refrigerants. Expressions are given for determining condensing coefficients, where a pure satur-

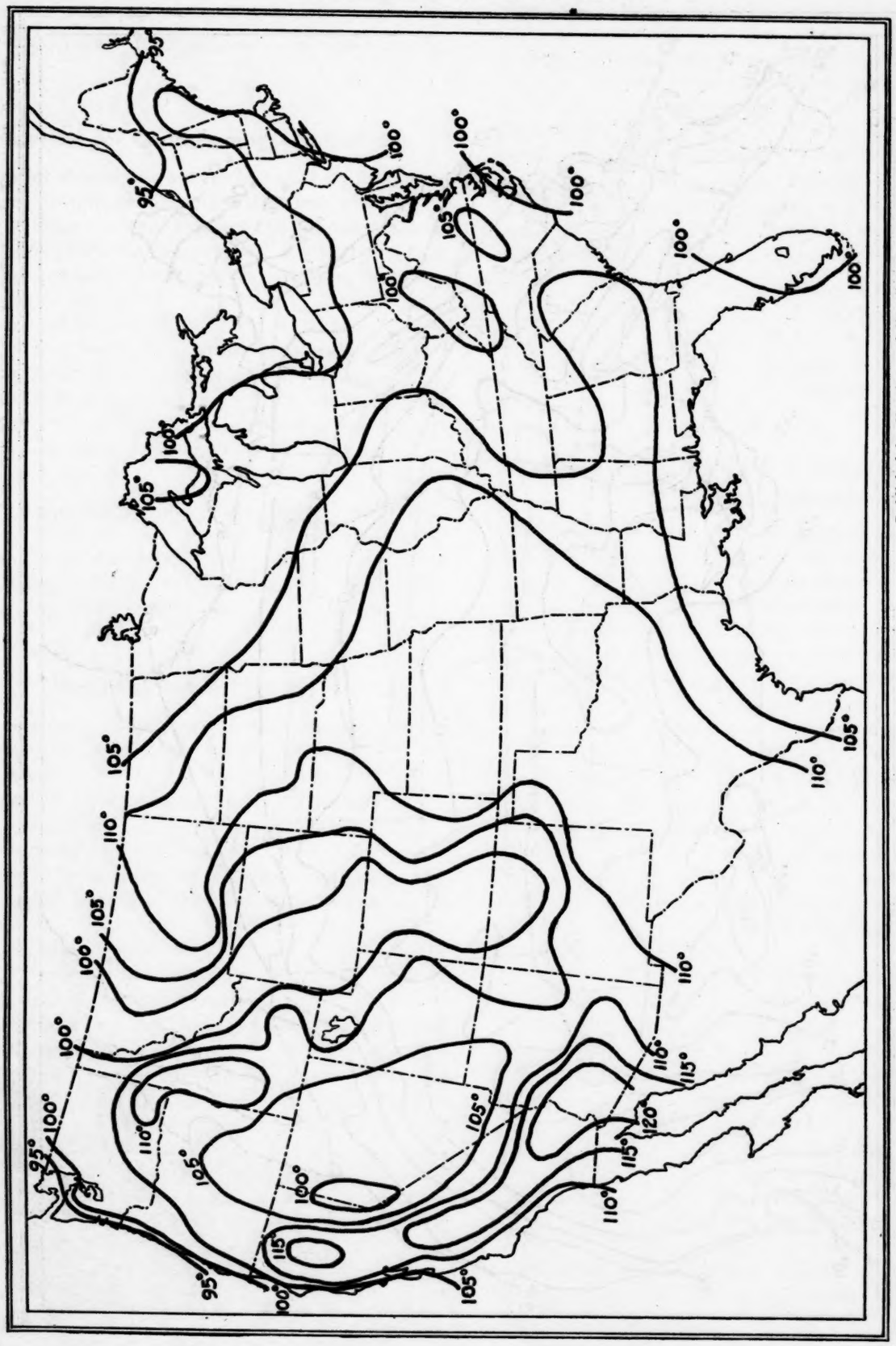
MINIMUM TEMPERATURES



Published by Heating and Ventilating, 148 Lafayette St., New York.

Lowest one-day mean temperatures, from United States Weather Bureau records up to 1925.

MAXIMUM TEMPERATURES



Published by Heating and Ventilating, 148 Lafayette St., New York.

The highest temperatures ever recorded in the shade at the regular United States Weather Bureau and selected cooperative stations are indicated on this chart.

H. & V.'s REFERENCE DATA—26

ated vapor is condensing, and a series of curves shows the results of actual tests.

[*Title: "Heat-Transfer Rates in Refrigerating and Air-Cooling Apparatus," by W. J. King and W. L. Knaus, both of General Electric Co., Schenectady, N. Y. Paper presented at annual meeting, A.S.M.E., New York, December* 6, 1933; *Approximately* 4000 *words.*]

●

Design of Dry Air Filters

This paper presents an analysis of the problem met in designing dry-type air filters for maximum efficiency, that is, for minimum resistance for a given area of unit. The conclusions are based on the hypothesis that in this type of filter the highest velocity attained by the air in its passage through the filter cell is the velocity through the medium itself.

After the filter medium has been chosen and the amount of air passing through it at a given resistance is established, the next important step is the proper arrangement of the filtering medium within the limited space of the filter cell. The author gives the results of a series of tests on filter units made up of pockets of different widths, depths, and spacings, using a number of sets of wire loops of varying widths. It was found in all cases that the capacity of the test unit increased as the depth of the pockets was increased up to approximately 4½ in., and beyond this depth the capacity was reduced, in spite of the fact that the greater depth provided a larger filter area. A series of curves is plotted to show these effects quantitatively.

Reason for this phenomenon is given as the increased resistance caused by the increased length of flow within the pockets after the filtering medium has been traversed. The vacuum within the felt-covered loops, drawing the air into the filter medium, is reduced as the depth of loop is increased, lowering the rate of flow of air per square foot of filter area.

[*Title: "Fundamental Principles in the Design of Dry Air Filters," by Otto Wechsberg, Coppus Engineering Corp., Worcester, Mass. Presented at the semi-annual meeting, A.S.H.V.E., Detroit, June,* 1933; *approximately* 2000 *words; diagrams; illustrations.*]

●

Test Method for Air Cleaning Devices

The problem of testing air cleaning devices resolves itself into the problem of establishing some definite and accurate standardized method for determining the amount of dust borne in an air stream. After describing the various methods usually resorted to in making these determinations and pointing out their inherent inaccuracies, the author enters into a description of a testing apparatus with which he has had considerable experience. The reliability of this device is unaffected by such factors as variations in nature of the dust, humidity, etc., and largely eliminates the human element from the determinations.

The apparatus in question gives dust quantities by weight. Artificially-prepared dust, simulating as closely as possible the dust suspended in the air over cities, is introduced into an air stream in measured quantity. After traversing the cleaning device a sample of the dust-laden air is withdrawn from the stream by a sampling tube in which the pressure is maintained at the same pressure as that obtaining in the air stream. The dust in the sample is collected in a porous crucible enclosed within a brass cup to which a reduced pressure may be applied. Accurate determination of the air flow in the main stream is made by reading the pressure drop across an orifice in the air stream. Suitable gauges are mounted on the apparatus for reading the pressure drop across the air cleaning device.

In conclusion the author suggests a standard form in which the specifications for air cleaning equipment may be written, as a basis for comparison of different filters.

[*Title: "Testing and Rating of Air Cleaning Devices Used for General Ventilation Work," by S. R. Lewis. Presented at semi-annual meeting, A.S.H.V.E., Detroit, June,* 1933; *approximately* 4000 *words; three diagrams; bibliography.*]

●

Comments on Psychrometric Data

Thermodynamic concepts and data pertaining to the properties of mixtures of air and water vapor have been proven to be at variance with actual conditions to a sufficient degree to seriously affect the accuracy of computations in this branch of air conditioning, and this paper points to the need for a better general understanding of the phenomenon.

Discussing the wet-bulb psychrometer, the authors state that it is the most practical indicating instrument for air conditioning work in spite of its inherent inaccuracies resulting from the effects of radiation, variations in velocity of the air stream, the temperature effects of impinging air, and the probable limit of rate of evaporation of water. Considerable improvement in design and mode of use is indicated before the instrument can be used for accurate measurement.

An error of at least —0.3% is reported for the amount of water vapor in a unit volume of air at atmospheric pressure when computed by the use of the ideal gas law, $PV = wRT$. These discrepancies are indicated by results of experiment on mixtures at high pressures, and the corrections for defects in the ideal gas laws for low pressures are not yet available. The effect of the pressure of the neutral gas in augmenting the vapor pressure is then taken up, and is shown to operate as does the ideal gas law defect to increase the amount of vapor contained in a unit of the neutral gas. The combined error of these two defects is additive, and probably increases the water vapor contained in a unit of air by between 0.4% and 0.5%.

[*Title: "Some Comments on Psychrometric Data," by Frederick G. Keyes and Leighton B. Smith, both of Massachusetts Institute of Technology. Paper read at annual meeting, A.S.M.E., New York, December* 7, *as a contribution from the Research Laboratory of Physical Chemistry, M. I. T.; Approximately* 3500 *words.*]

News of the Month

Over $10 Million More for Public Building

Loans, grants and allotments totalling $10.7 million were made by the Federal Emergency Administration of Public Works for buildings during the period from November 11-25, inclusive. Of this total, $9.8 million were for non-Federal projects, the remainder being for the U. S. Government work.

The largest single item in the non-Federal appropriation was that of nearly $3 million in the form of a loan and grant for buildings at the Tuberculosis Hospital, Laurel Hill, N. J.

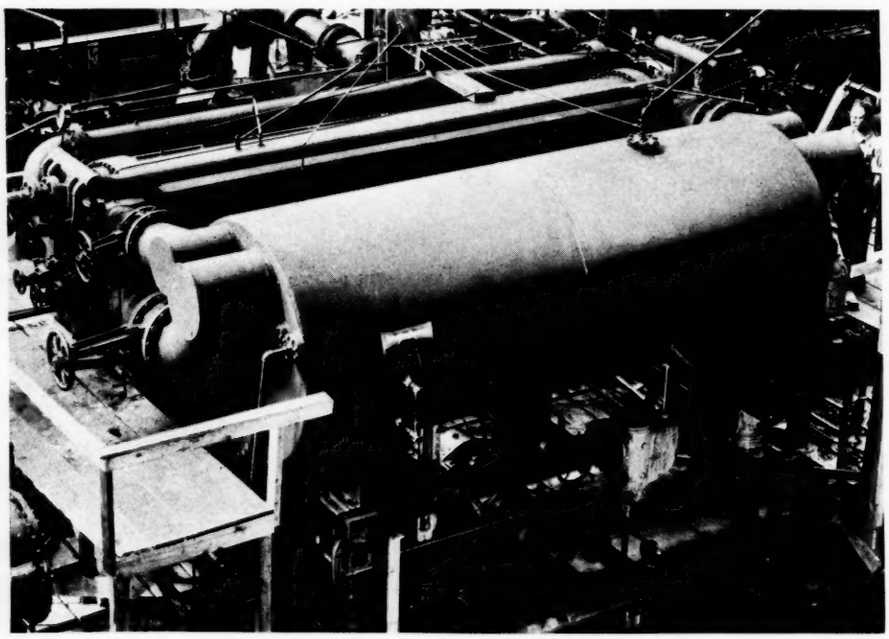
These appropriations bring the building total of $297.5 million, as reported on these pages last month, to a total of $308.2 million allotted under the public works program.

Utility Men Study Air Conditioning Market

An all-day meeting on air conditioning at which the various marketing phases of the industry were discussed, was held recently by Westinghouse Electric & Mfg. Co. at East Pittsburgh, Pa., for 35 officials of the West Penn Electric Company, which serves western Pennsylvania and West Virginia.

R. A. Neal, central station sales manager, pointed out that the air conditioning load is desirable to utilities by virtue of its diversity factor, power factor, load factor, and off-peak demand. A. C. Streamer, sales manager of diversified products, speaking with regard to the permanency of the market, stated that air conditioning will stay sold with the public if each installation is accurately estimated, correctly engineered, properly installed, and adequately serviced, and that installations that are inadequate as to capacity and function will react unfavorably against manufacturers in future sales efforts.

F. R. Kohnstamm, Westinghouse sales promotion manager, reporting on a survey of the air conditioning market just completed, characterized the immediate market as lacking in educated demand for air conditioning, and restricted in buying power. The survey revealed that all branches of the industry are in agreement that the principal market next year will be in the commercial field, including executive and general offices of commercial and industrial establishments. The survey indicates that the residential market is not yet ready for vigorous cultivation. The report stresses the need for trained men in the industry.



La Maison Francaise, Rockefeller Center, New York, will be supplied with chilled water for air conditioning purposes by this 300-ton capacity steam jet refrigeration unit, here shown on the test floor of the South Philadelphia Works of Westinghouse Electric & Manufacturing Company, the manufacturer. The unit comprises four booster ejectors, two of which have approximately 20% of total capacity each, and two of which have approximately 30% of total capacity each, resulting in a high degree of flexibility of operation.

Fan, Unit Heater and Convector Codes Set for Hearing

National Recovery Administration gave notice December 18 that a hearing on three related manufacturing industries would be held at 10 a.m. Thursday, December 28, in the Jefferson Room of the Mayflower Hotel before Deputy Administrator Barton W. Murray. The three industries are sponsored by the following organizations, which present the codes:

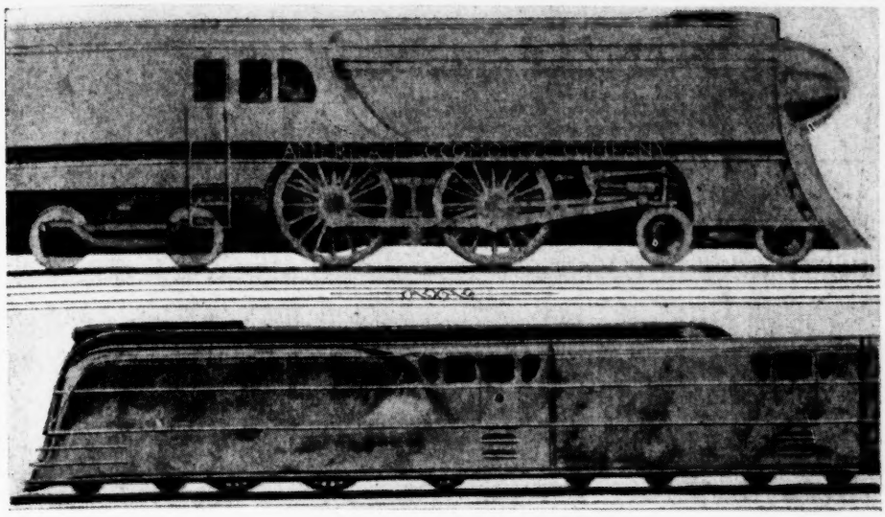
Industrial Unit Heater Association, claiming to represent 80% of the industry; National Association of Fan Manufacturers, claiming to represent 89% of the industry, and Concealed Heater Manufacturers Association (Concealed Radiator Industry), claiming to represent 80% of the industry.

The three proposed codes are substantially uniform as to hours, an average 40-hr. work-week being provided with an 8-hr. day. In peak seasons the week can be extended to 48 hr.

The minimum hourly wage for general employees in the fan and blower industry would be 35 cents with a minimum of 40 cents an hour in the other two industries. Clerical employees and office workers would receive minimum compensation ranging from $14 to $15 a week according to population of the cities in which they are employed.

Railroads Rapidly Expanding Number of Air Conditioned Cars

Increasing use of air conditioned rolling equipment by railroads operating in all sections of the country indicates that this measure has proven generally profitable in reclaiming passenger revenue from rival transportation facilities.



Air conditioning machinery is in the tenders of these streamlined steam locomotives, designed by Otto Kuhler for the American Locomotive Company, and designed to reach a maximum speed of 120 miles an hour. Top illustration shows wheels of locomotive exposed; wheels concealed in bottom illustration. In each type the cowcatcher is retained in rounded form with horizontal, anti-climbing ribs, which serve also as steps by which upper works may be reached.

By the summer of 1934 all through trains of the Pennsylvania Railroad, and the principal trains of the New York Central Railroad will be made up of air conditioned cars. Installation of the Pennsylvania's additional equipment has already been started, and will bring the total of that company's conditioned cars to nearly 700. During the past summer New York Central cars were pre-cooled by platform refrigerating units at terminals and main points along its routes, and this equipment will be retained in service with sleepers, dining cars, chair cars, and some coaches carrying conditioning apparatus.

Part of the loan of 3½ million allotted the New Haven Railroad by the Public Works Administration will be applied to the air conditioning of 142 of the company's latest steel cars.

A recent announcement of the Seaboard Air Line Railway, states that its *Orange Blossom Special,* operating between New York and points in Florida has been completely air conditioned.

F. M. de Beers Representing Croll-Reynolds

Croll-Reynolds Co., Inc., New York, announces that F. M. deBeers, former president of Swenson Evaporator Company, will handle in the middle west its Chill-Vactor equipment for use with air conditioning systems and industrial cooling operations. Mr. deBeers will retain his headquarters at 20 North Wacker Drive, Chicago, and will also continue to represent Leader Industries, Inc.

Croll-Reynolds Company reports that 1933 sales of their steam jet Evactors as used in vacuum refrigeration have exceeded those in any other of the 15 years since it started manufacturing this equipment.

Wisconsin University Offers Home Course

A correspondence course in heating and ventilating engineering is offered by the University Extension Division, University of Wisconsin, Madison. The course consists of 24 assignments, and instruction fee is $24 for non-residents of Wisconsin and $15 for residents of the state. Heat-power engineering is required as a prerequisite.

Contractors to Discuss Code at Atlantic City

A special one-day meeting of the Heating, Piping and Air Conditioning Contractors National Association, to amend the by-laws and to discuss the administration of the Code of Fair Competition, will be held at the Ambassador Hotel, Atlantic City, N. J., January 8. The session will commence at 9:30 a.m. and continue until the business is completed. All interested contractors will be welcome.

There will be a meeting of the Board of Directors at 10 a.m. at the Ambassador on January 6, when a meeting of local secretaries has also been arranged.

Electrol Removes Factory to New Jersey

Electrol Incorporated has moved its factory from St. Louis, Mo., to 934 Main Ave., Clifton, N. J.

Lionel Jacobs, formerly president of Electrol of New Jersey, Inc., is in charge of entire factory operation. Electrol of New Jersey has been consolidated with the Electrol factory branch at East Orange, N. J., both companies now being located in the new showrooms of the factory at Clifton.

Exposition to Have Wide Appeal

Numerous operating models to be on display at the Third International Heating and Ventilating Exposition, which will take place at Grand Central Palace, New York, February 5-9 in conjunction with the 40th annual meeting of the American Society of Heating and Ventilating Engineers, will tell a graphical and coordinated story of achievements in heating, ventilating, and air conditioning endeavor. Equipment finding application in all classes of buildings will be exhibited, and will constitute a spectacle of interest to engineers, scientists, builders, operators, and homeowners alike.

The two years that have passed since the last exposition have witnessed unusual activity in the development of new products and the refinement of old ideas. Great strides have been taken in scientific and engineering achievement, and the exposition will afford an excellent opportunity to both laymen and those actually engaged in the industry to bring their knowledge of modern practice up to date.

News of the Month

Perhaps no other branch of the industry has made such advancements as have the manufacturers of control equipment for heating, ventilating, and air conditioning apparatus. An electrically-operated weather-controlled heating system will be on display for the first time. Automatic firing equipment, boilers, direct and indirect heating surfaces, heating specialties, and many other kinds of apparatus will be exhibited.

Special sections will be devoted to warm-air heating, refrigeration as applied to air conditioning, oil heating, and gas-fired heating appliances. About 150 manufacturers will be represented.

Illinois Engineers Hear Talk on Gas

H. E. Bates, assistant chief engineer of the People's Gas Light and Coke Company, addressed the Illinois Chapter, A.S.H.V.E., at its regular monthly meeting held December 11 at the Sherman Hotel, Chicago. Mr. Bates' subject was "Supplying Gas to the City of Chicago," under which he outlined the characteristics of the various fuel gases and described the processes of production. Problems of distribution were also discussed.

Steam Jet Refrigeration Discussed in New York

The history, design, and operating principles of steam vacuum refrigeration were discussed by Frederick D. Berkeley in a talk before the New York Chapter of the A.S.H.V.E., December 18. Approximately 75 members and guests were present.

Chairman Arthur Ritter announced the social program prepared by the committee for the annual meeting of the Society, to be held at the Biltmore Hotel, New York, February 5-8. Monday night, February 5, the President's reception and dance, in charge of Alfred Engle, chairman, will be held, while on Tuesday afternoon, February 6, there will be bridge and tea for the ladies, which will be in charge of Charles S. Hoffman, chairman. Wednesday evening, February 7, there will be the annual banquet and dance in charge of a committee of which H. Berkeley Hedges is chairman. In the morning of February 8 there will be an inspection trip for the men through Radio City, under the direction of William L. Kiplinger, chairman. In the afternoon a Radio City theater party for the ladies will be held, in charge of Mr. Hoffman.

W. W. Timmis is chairman of the general reception committee; F. E. W. Beebe is chairman of the finance committee.

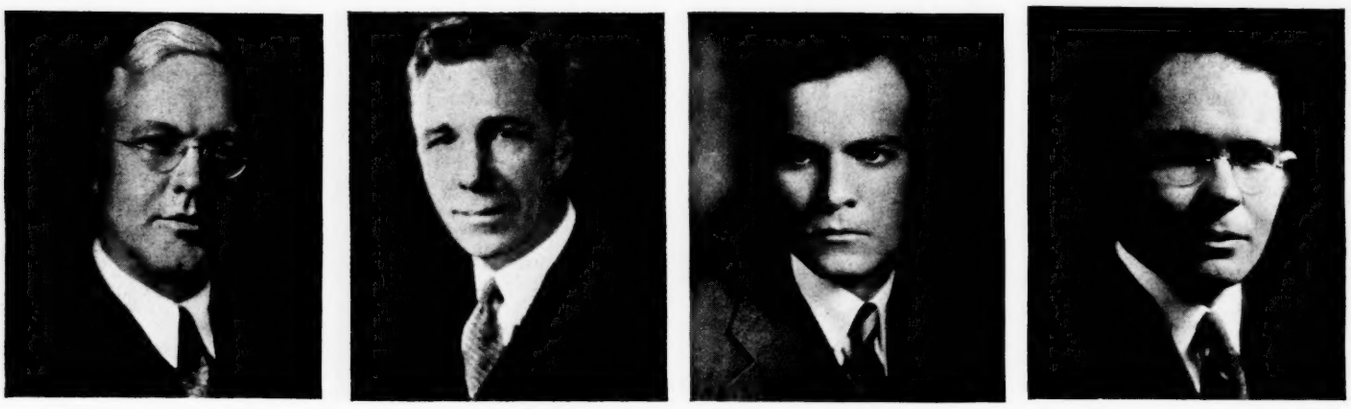
Improved Business is Foreseen at N. W. A. H. & A. C. A. Convention

H. T. Richardson, jovial new president of the National Warm Air Heating and Air Conditioning Association, returned from the association's annual convention, held at Cincinnati, December 5-6, expressing confidence in the future of warm-air heating and gratification for the manner in which the industry has cooperated with the association in the formulation and acceptance of a code of fair competition. The code was submitted as signed by President Roosevelt at the manufacturers' meeting, held the afternoon of December 5, and was unanimously ratified by those in attendance, representing more than 80% of the furnace manufacturing industry.

Administration of the code will be in the hands of a code authority committee composed of the following: W. L. McGrath, chairman, C. Ackerson, A. F. Frazee, F. E. Mehrings, Dana W. Norris, C. A. Olsen, and H. T. Richardson.

W. L. McGrath, the retiring president, opened the first session with an address which was followed by "Present Government Activities and Business," an address by the Hon. Arthur P. Lamneck, Representative to Congress from Columbus. Dana W. Norris then spoke on "The Cans and Can'ts of Air Conditioning." The report of the Committee on Installation Codes was rendered by Prof. J. D. Hoffman, who brought the accepted code for mechanical systems before the assembly.

The research session was held on the morning of December 6, and opened with a report of the Research Advisory Committee, by F. G. Sedgwick, chairman. The association's research activities were summarized by Prof. Arthur C. Willard. This was followed by Prof. Alonzo P. Kratz' paper, "Factors Affecting Human Comfort in Heating and



NOMINATED FOR RESEARCH COMMITTEE

C. A. Booth, John Howatt, A. J. Nesbitt and J. H. Walker, among members nominated to Committee on Research, A.S.H.V.E. Other nominations include: President, C. V. Haynes; first vice-president, John Howatt; second vice-president, G. L. Larson; treasurer, D. S. Boyden.

H. T. Richardson, vice-president of the Richardson & Boynton Co., New York, was elected president of the National Warm Air Heating and Air Conditioning Association. Mr. Richardson is also a vice-president of the Eastern Supply Association.

Ventilating." The session concluded with the presentation of "Summer Cooling Studies in the Research Residence During 1933," by S. Konzo.

Arthur F. Frazee opened the afternoon meeting with a discussion of conditions in the industry, after which Frank C. Lyons addressed the convention on "Air Conditioning as a Factor in National Recovery." Election of officers completed the business of the convention. Associated with Mr. Richardson in the administration of the society's affairs for the coming year are: W. L. Rybolt, first vice-president; L. R. Taylor, second vice-president, and A. W. Williams, managing director and treasurer.

The Williamson Heater Company was host to the association at an enjoyable entertainment on the evening of December 5.

O. B. C. A. Decentralizes Activities

W. F. Schroeder, St. Louis, has been appointed western field representative of the Oil Burner Code Authority to carry on the recently announced program of decentralized administration of the industry through establishment of 462 competitive sales areas throughout the country. Mr. Schroeder will assist in organizing local administrative groups in important marketing centers in western states. During December 22 meetings were scheduled for this purpose in both the eastern and the western division of the country.

Morgan J. Hammers, chairman of the O.B.C.A., and Harry F. Tapp, executive secretary, conferred with 17 representatives of industrial burner manufacturers in New York on December 5, at which time a plan was evolved whereby the present code can meet the problems of the industrial burner manufacturers as distinct from the problems of the other groups administered under the code.

Government Studies Building Market

An inventory of real property, to secure basic facts regarding the extent of use of existing housing facilities, extent of vacancy, degree of overcrowding, financial situation, and other data of value to the construction industry, has been undertaken by the Department of Commerce, under the authority of the Civil Works Administration. The survey will be made in a number of selected cities in all sections of the country.

Willard L. Thorp, Director, Bureau of Foreign and Domestic Commerce, under whose supervision the work is being carried on, states that the need for such information is indicated in many parts of the country where there have been periodic phases of over-building with no definite planning, no definite information as to whether or not there was a market for the buildings, whether population trends favored, or whether wages and salary totals were sufficient. The program is in line with the Government's policy of planning carefully for the future, and will enable private initiative, guided by real property inventories, to save itself from disastrous errors. The project, which is to be completed by February 15, is providing work for more than 11,000 people.

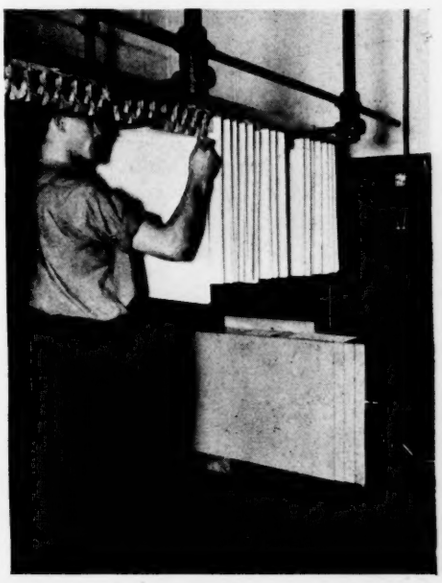
Heating Research at Mellon Institute

An announcement by Dr. Edward R. Weidlein, director, Mellon Institute of Industrial Research, Pittsburgh, reports that the Multiple Industrial Fellowship on heating, sustained in the Institute since 1929 by the National Radiator Corp., Johnstown, Pa., is continuing actively a number of investigations of interest to heating specialists and users of heating equipment. In addition, increasing consideration is being accorded research problems in air conditioning by Dr. J. L. Young and A. C. Jephson, incumbents of the Fellowship.

Results of the investigations, to be published at length at the conclusion of the Fellowship's program, will include their findings on the comparison of non-ferrous and cast-iron finned surfaces for convection heating, and the results of work on impregnated wood foundry patterns.

A.C. Forum Planned for St. Louis

An open forum on air conditioning, embracing eight evening lecture and discussion periods, has been arranged by The David Ranken, Jr. School of Mechanical Trades, St. Louis, Mo., commencing January 15, and meeting on successive



This air conditioning unit, installed in the paper storage room in the press room of The Maqua Printing Co., Schenectady, maintains the humidity within correct limits for the proper conditioning of paper for use in the offset printing process. Two humidistats, located on the wall of the room, start and stop the unit when the required upper and lower limits are reached.

Monday evenings to March 5.

Meetings will be open without cost to anyone interested in the subject. They are being conducted for the purpose of acquainting the public with the value of air conditioning from the standpoint of health and comfort, to present the facts pertaining to the methods of accomplishment, and to correct some public misconceptions. The discussions will be of interest to engineers, architects, mechanics, and salesmen.

Texas Gas Utilities Display Degree-Day Charts

In the lobby of the commercial office of the Dallas Gas Co., Dallas, Tex., is a large degree-day explanatory chart by which heating requirements for a given period of the current year are compared graphically with those of the corresponding period of the preceding year for the benefit of customers and employees. The chart contains three graphs, located one above the other, the top graph representing the mean temperature curve for that locality for the previous year. The area below 65°, the datum line for degree-day computations, is shown in yellow, and temperature degrees are indicated by horizontal lines.

A graph showing mean temperature for the current year is second from the top. The curve is extended daily upon receipt of government weather reports. The bottom chart contains degree-day deficiency curves, accumulative for 30-day periods, for the present and previous heating seasons, enabling the employee to present to the customer a graphic picture of how degree-day deficiency governs the gas consumption for heating purposes.

Similar charts are posted in the offices of the West Texas Gas Company in each of the 40 towns it serves, and in addition, this company encloses with monthly statements a small folder detailing weather conditions as they relate to heating load for preceding 30-day periods.

Both companies report that this method has proven effective in aiding office managers to explain seeming inconsistencies in customers' bills.

1931 Was Warmest Year in Eastern Cities

The following table was prepared from official reports of the respective Weather Bureau stations. It gives the normal annual temperature; the number of years when the annual mean temperature was above and below the normal during the past 60 years; also the absolute highest and absolute lowest temperature:

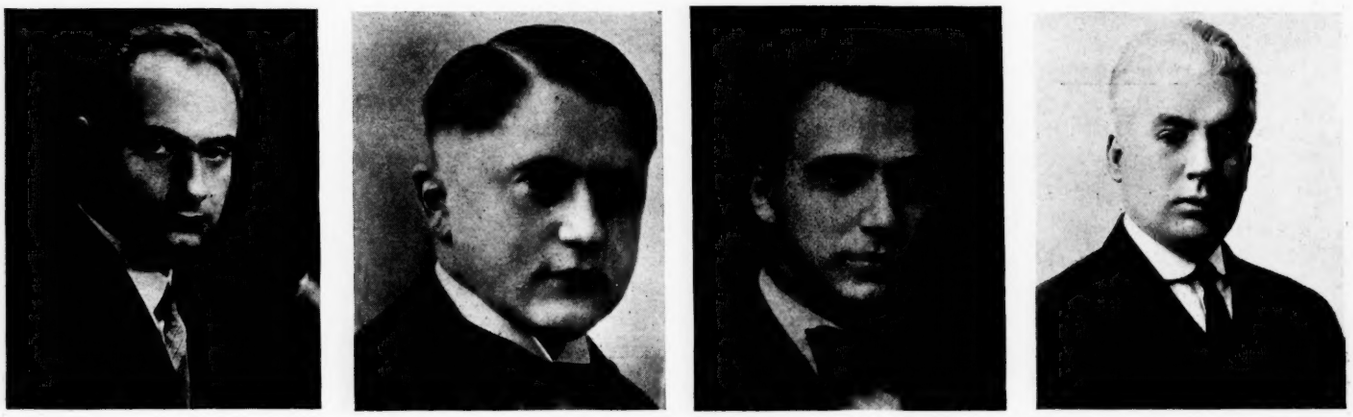
Records at all these stations agree in that the year 1875 was the coldest, and that 1921 was the warmest at St. Louis and Chicago, and 1931 at Pittsburgh, New York, and Boston.

Stations	Annual Normal Temp.	Number Years Mean Above Normal	Number Years Mean Below Normal	Absolute Maximum Temp.	Absolute Minimum Temp.
St. Louis	56.2	34	26	108	— 22
Chicago	49.2	35	25	103	— 23
Pittsburgh	52.8	32	28	103	— 20
New York	52.3	29	31	102	— 13
Boston	49.8	32	28	104	— 14

Engineering Societies Hold Annual Meetings

Air conditioning was the subject of a joint session held at the Engineering Societies Building, December 7, by the American Society of Mechanical Engineers and the American Society of Refrigerating Engineers, gathered in New York for annual meetings during the week of December 4. Clyde R. Place, consulting engineer, New York, presided over the session.

Dr. F. G. Keyes, Massachusetts Institute of Technology, presented the first paper, "Psychrometric Investigations and Data," written in collaboration with Leighton B. Smith, also of the Institute's faculty. This was followed by "Physiological Side of Air Conditioning," by R. R. Sayres, Medical Officer in Charge, Bureau of Industrial Hygiene and



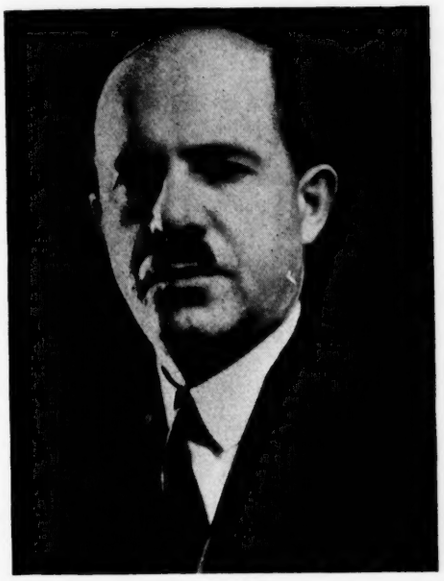
REWARDED FOR SCIENTIFIC ACCOMPLISHMENT

H. L. Galson, Henry C. Heller, Hans K. Steinfeld and C. R. Neeson—awarded the John Scott medals by the city of Philadelphia for their achievements in making reversed refrigeration practical. As associates of the Baldwin-Southwark Corp., Philadelphia, they designed and developed the De La Vergne air conditioner, an arrangement of a refrigerating machine for cooling and heating buildings.

Sanitation, U. S. Public Health Service, Washington.

Doctor Sayre discussed the effects of the various factors of air conditioning upon the human system. He named the amounts of gases and dilutants, both toxic and non-toxic, that may be present in the air without harmful effect on human beings. The subjects of air cleaning and ionization were also covered in the paper.

Followed "Noise Elimination and Air Motion," a paper by C. B. Graves, manager, Air Conditioning Division, Campbell Metal Window Corp., New York. Mr. Graves classified the different noises and described their injurious effects upon individuals at work and at rest. The methods of combating these outside noises, as well as the noises arising in the mechanical equipment itself, are outlined in the paper.



25 Years Ago in

The Heating Ventilating Magazine

JANUARY, 1909

ELECTED TO MEMBERSHIP in the A.S.H.V.E. at the society's annual meeting were Laurence C. Soule, American Radiator Company, Louis K. Berman, Raisler Heating Company, and W. W. Macon, editor, *The Metal Worker*.

A LAW PASSED at the last session of the Wisconsin State Legislature authorizes each rural school district to spend $50 for the ventilation of schoolhouses There is much speculation as to the purpose of the law, as country schoolhouses as a rule are notoriously well ventilated through ill-fitting windows, broken floors, and worn-out doors.

PROF. WILLIAM KENT, formerly dean of the L. C. Smith School of Applied Science, Syracuse University, Syracuse, N. Y., has been appointed general manager of the Sandusky Foundry & Machine Co., Sandusky, Ohio.

UTICA HEATER CO., Utica, N. Y., has increased its capital stock from $100,000 to $175,000, the increase being classified as first preferred stock.

A BONUS, amounting to 10% of yearly wages, was distributed to its employees by Crane Co., Chicago, at Christmas.

WARREN WEBSTER & CO., Camden, N. J., announces extension of its organization from coast to coast. The business formerly carried on by the American Engineering Specialty Co., Chicago, with branches and agencies in various cities throughout the middle west, will be conducted under the name of Warren Webster & Company.

A MEETING has been arranged for the evening of January 19 in the Engineering Societies Building, New York, between the A.S.H.V.E. and committees representing the Boiler and Radiator Manufacturers' Association and the National Association of Master Steam and Hot Water Fitters, to discuss the proposed revision of the ratings of house-heating boilers.

INCLUDED IN THE PROGRAM for the annual meeting of the American Society of Heating and Ventilating Engineers, to be held January 19-21, 1909, are: "Miniature Steam Traps and their Application to Steam Circulation," a paper by James A. Donnelly; "The Position of the Heating and Ventilating Engineer before the Public," an address by D. D. Kimball, and "The Rating of House-Heating Boilers," a paper by Prof. William Kent.

News of the Month

On the preceding day, F. D. Berkeley, Ross Heater Company, opened the morning session of the A.S.R.E. meeting with "Applications of Vacuum Systems." This was followed by "Coordination of Research and Engineering with Production and Sales," a paper presented by J. S. Beamensderfer, York Ice Machinery Corporation. Walter L. Fleisher delivered his paper, "The Condenser Water Problems," at the afternoon session.

At the A.S.M.E. Heat Transfer Symposium, held in the Engineering Societies Building, December 6, W. L. Knaus, General Electric Company, read a paper, "Heat Transfer Rates in Refrigerating and Air Cooling Apparatus," which was followed

HEADS OF A.S.R.E.

Upper left, A. R. Stevenson, Jr., president; lower left, Harry Harrison, vice-president; upper right, C. T. Baker, treasurer, and lower right, David L. Fiske, secretary, of the American Society of Refrigerating Engineers.

by a discussion by W. J. King, co-author of the paper with Mr. Knaus. F. C. Houghten's paper, "Heat Transfer Rates in Heating and Ventilating or Air Conditioning Practice," was presented at the same session by Dean Paul F. Anderson, University of Kentucky, who commented upon the use of "common sense" in handling air conditioning problems.

F. L. Sahlman, General Electric Company, opened the Friday morning session of the A.S.R.E. meeting with his paper, "Methods of Passenger Car Cooling," in which the various systems were described and illustrated. Mr. Sahlman presented data to show that air conditioning has proven profitable to railroad operators. This was followed by "Unit Equipment for Restaurants, Offices, and Stores," by W. C. Goodwin, Westinghouse Electric & Manufacturing Company. The technical sessions concluded with the reading of "Air Conditioning Operation in a Rayon Plant," by W. C. Giles, the Viscose Co., Marcus Hook, Pa.

Paul Doty, St. Paul, Minn., was elected president of the A.S.M.E. for 1934. New officers of the A.S.R.E. are as follows: President, A. R. Stevenson, Jr., Schenectady, N. Y.; vice-president, S. C. Bloom, Chicago; treasurer, C. T. Baker, Atlanta, Ga.

Coonley Reelected A.S.A. Head

Reelection of Howard Coonley, president, Walworth Co., New York, to the presidency of the American Standards Association, was announced at the Association's annual meeting, December 13, at the Astor Hotel, New York. F. E. Moskovics, Indianapolis, was again elected to the vice-presidency.

Elwood to Head Dustop Sales

Owens-Illinois Glass Co., Toledo, Ohio, has announced the appointment of James L. Elwood as sales manager for Dustop glass-wool air filters. Mr. Elwood was previously

James L. Elwood, new sales manager for Dustop air filter division of Owens-Illinois Glass Co.

associated with the Industrial Materials Division of the company, before which he was with General Motors Corporation. F. L. Myers continues in active charge of sales and engineering of Dustop filters, as applied to warm-air furnaces and air conditioning.

Grimes Appointed to War Department

Oliver J. Grimes, managing director of the Committee of Ten, Coal and Heating Industries, Inc., has been appointed Executive Assistant to Secretary of War Dern.

Mr. Grimes, who formerly acted as secretary to Mr. Dern, will continue to act in an advisory capacity for the Committee of Ten, and carry on the work incident to promoting Bituminous Coal Research, Inc. He was at one time secretary of the Utah Coal Producers Association.

Representing Administration on Code Authorities

Names of Administration members appointed to 90 of the Code Authorities created under approved Codes of Fair Competition were made public December 13 by National Recovery Administrator Hugh S. Johnson. Representatives of the Administration for the various mechanical equipment industries are as follows: Automatic Sprinkler, Ralph J. Fogg; Boiler Manufacturing, Heat Exchange Pump Manufacturing, and Steel Tubular and Firebox Boiler, Neal W. Foster; Cast-Iron Soil Pipe and Gas Appliances and Apparatus, H. M. Halsted, Jr.; Oil Burner Industry, R. B. Paddock, Leuren E. Seeley, Harold Sweatt, and Harry F. Tapp; Pipe Nipple Manufacturing, William Lawson; Warm-Air Furnace, Beverly S. King.

Brookbank New Century Distributor in Washington, D. C.

J. S. Brookbank, formerly sales manager of the L. P. Steuart & Brother Co., Washington, D. C., has become a distributor for the Century Engineering Corp., Cedar Rapids, Ia., with temporary headquarters at 2701 14th St., N.W., Washington.

Rock Wool Distributors Meet

Representatives of eastern distributors of the Capitol Rock Wool Insulation Division of the Standard Lime and Stone Co., Baltimore, met in that city for their annual convention, December 8-9. Sales manager Frank C. Russell presided over the business meetings, at which merchandising policies and future plans were under discussion. On the first day of the meeting, the delegates were conducted on a tour of inspection of the plant properties at Millville, Martinsburg, and Bakerton, W. Va.

Electrol and Scott-Newcomb Settle

All outstanding litigation and other controversies between Electrol Incorporated, St. Louis, and Scott-Newcomb, Inc., St. Louis, have been settled and concluded, according to an announcement by Lewis L. Scott, president of the latter company.

Airoil Purchases Factory

National Airoil Burner Co., Inc., 1327 Girard Ave., Philadelphia, has purchased the two-story factory, located at 1234-56 East Sedgley Ave., Philadelphia, formerly occupied by the Franklin Hosiery Mills. All manufacturing activities of the

Airoil Company will be transferred to the new location, containing about 40,000 sq. ft. of floor space, the offices and sales rooms to remain at the old address.

NEW CATALOGS

The Carbondale Machine Co., Carbondale, Pa., has issued Bulletin 1133, "Carbondale Combined Units with Duplex Vertical Ammonia Compressors." Describes and illustrates this equipment, featuring such details as strip plate inertia valves, tapered roller bearings, Cooke seal packing, etc. Includes dimensional and engineering data; standard size, 7 pages.

Crocker-Wheeler Electric Manufacturing Co., Ampere, N. J., has issued a bulletin describing its line of electric motors, generators, speed changers, flexible couplings, and related equipment; standard size, 12 pages.

The Ideal Electric and Mfg. Co., Mansfield, Ohio, has issued Bulletin 710, describing Ideal capacitors for power factor correction. Contains a brief explanation of power factor, and includes tables for determining the correct capacitor to meet a given requirement; standard size, 16 pages.

Ilg Electric Ventilating Co., 2850 North Crawford Ave., Chicago, has issued Catalog 833, describing its line of Universal blowers. Engineering data are included, and latest installations are described and illustrated; standard size, 40 pages.

The Peerless Electric Co., Warren, Ohio, has issued its 1934 air conditioning catalog, describing direct connected blowers for warm-air furnaces, forced-draft blowers, exhaust blowers, ventilating blowers, and bonnet switches. Also contains instructions for making forced-air heating calculations.

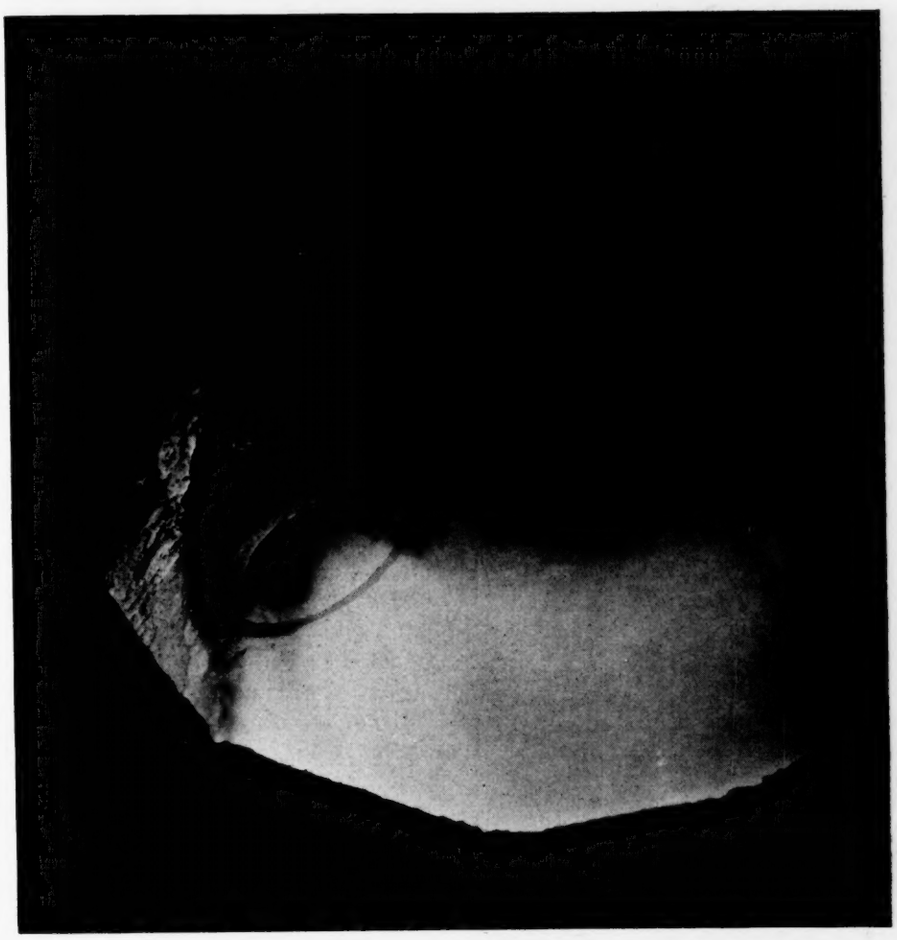
F. I. Raymond Co., 629 West Washington Blvd., Chicago, has issued a new instruction manual giving installation details for the Duo-Stat control for steam heating systems. Includes wiring diagrams, typical installations, directions for selecting the control radiator, special applications, and a summary of common installation faults and their corrections. Page size, 5½ in. × 8½ in.; 72 pages.

Republic Steel Corp., Central Alloy Div., Massillon, Ohio, has issued a booklet, Form Adv. 220-B, describing Enduro 4.6% chromium steels, available in all usual forms including sheets, plates, strips, bars, etc. Physical and engineering characteristics are listed; standard size, 9 pages.

Republic Steel Co., Youngstown, Ohio, has issued two booklets, "The Technical Story of Toncan Iron Pipe," and "Toncan Iron Pipe for Permanence." The former, 24 pages, covers the manufacture, applications, and performance of this product, and the latter, 64 pages, includes engineering data and characteristics, and illustrations and service records of a wide variety of applications. Both are standard size.

Richardson & Boynton Co., 244 Madison Ave., New York, has issued a folder, "Practical Engineering Data for Oil Burner Installation," for distribution to dealers of oil-burning equipment. Contains general information on converting boilers to oil burning, design of combustion chamber, burner settings, and bricking, in addition to capacity data as determined from tests; standard size, 8 pages.

Tube-Turns, Incorporated, 1300 South Shelby St., Louisville, Ky., has issued Bulletin 51-1, describing its complete line of thin gauge copper Tube-Turns, elbows and return type fittings for use in distillery and brewery process lines. Contains dimensional and other engineering data.



Looking into the combustion chamber of a Wayne boiler, one of the many striking illustrations in the Wayne Oil Burner Corporation's new booklet "The Evidence Points to Coalitosis." This Fort Wayne, Indiana, company has recently launched an intensive campaign on its Mistoil burner and boiler-burner unit.

New Equipment

Zone Control for Residential Forced-Air Systems

Controls for zone heating with forced-air or air conditioning systems are described in a recent announcement of the manufacturer, the Detroit Lubricator Co., Detroit, Mich. The system is designed to overcome the difficulty generally met in attempting to maintain a uniform temperature throughout residences having many rooms or of rambling construction when the entire building is controlled by a single thermostat.

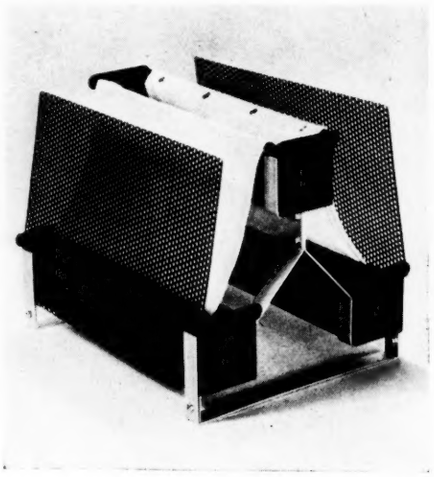
With this system, the house is divided into two or more zones, each zone being supplied by a separate main duct with suitable branches. A thermostat placed in one of the rooms in each zone regulates the operation of a damper motor unit in the zone duct to maintain uniform heat in that section.

The damper motor unit, Catalog 431, is of the thermal motor type. A low-voltage, low-temperature electric heating element is inserted in a chamber containing a volatile liquid, and when the thermostat completes the circuit through the element, some of the liquid is volatized, increasing the internal pressure and expanding a bellows to open the damper. Opposing the bellows is a spring which normally keeps the damper closed. When the circuit is broken by the thermostat, the pressure is relieved and the damper closes. The motor unit is wired in parallel with other similar motor units controlling the other zones, and this circuit is connected to the damper motor on the furnace or to a relay controlling an automatic firing device. When a motor unit closes the damper, the circuit is broken, closing off the heat supply and stopping the blower unless the thermostat in another zone is calling for heat, in which event the system remains in operation until all thermostats are satisfied.

Motor unit No. 431, for zone control

Humidifier Installed Over Register

A portable humidifier, to be placed over a warm-air register, has been announced by the Taylor Instrument Companies, Rochester, N. Y.

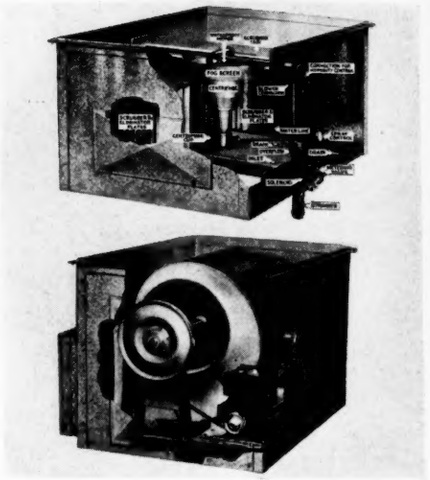


Taylor humidifier

This device consists of three water pans into which two fabric wicks are immersed. Perforated plates are placed so as to promote the maximum circulation of warm air over the evaporating surfaces. Frame, pans, and ventilating plates are constructed of brass, and wicking is of highly absorbent material. About 200 sq. in. of evaporating surface are provided, sufficient to add approximately 9 qt. of water to the air per day, according to the manufacturer.

Comfortrol Conditioning Units

Comfortrol air conditioning equipment, for use in conjunction with warm-air heating systems, has been announced by The Waterman-Waterbury Co., 1121 Jackson St., N.E., Minneapolis, Minn.



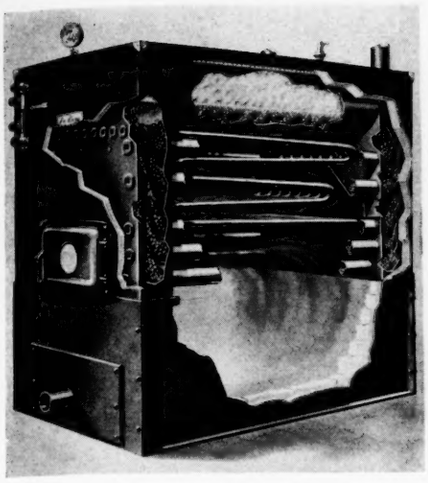
Comfortrol washer and fan unit

Washer, filter, and fan units are enclosed in separate casings, mounted vertically, one upon the other. Air is brought into the washer unit at the top, where it is washed and humidified by a spray from a centrifuge, driven by a 1/20-hp. motor, arranged to start and stop with the fan motor. Spray volume is controlled by raising or lowering the level of water in a cup at the bottom of the centrifuge. The washer is equipped with a metering valve and a solenoid valve which shuts off all water when the fan stops.

From the washer the air passes downward through the middle section which contains the Dustop filters. After traversing the filters it is drawn into the fan unit from which it is discharged into the casing of the warm-air furnace where it is heated and delivered to the living quarters. All moving parts of the blower unit are fully enclosed within the casing, and fan and motor are carefully insulated to prevent transmission of sound to the casing and ductwork.

Water Tube Heating Boilers Announced

Rapid steaming, positive water circulation, and economical operation, are among the advantages claimed for the De Luxe steel water tube heating boiler by its manufacturer, the Smith Twin Tubular Boiler Co., State Road and Cottman St., Philadelphia. These boilers, de-



Smith De Luxe water tube boiler

signed expressly for oil burning, are manufactured in 15 sizes, ranging in capacity from 800 sq. ft. to 4800 sq. ft. of equivalent direct steam radiator.

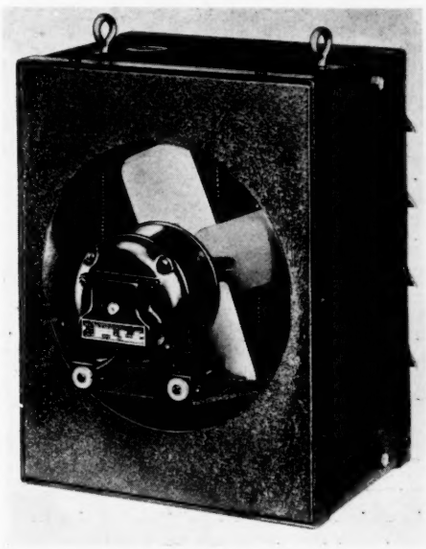
The lower section, forming the combustion chamber, is constructed of steel plates, bolted together ready for the installation of the necessary refractory by the oil burner contractor. The top section consists of drums and tubes of flanged boiler steel, assembled into a single unit, and designed for efficient absorption of radiant heat. The water is divided into thin layers directly over the fire, and is circulated rapidly through the 1-in. tubes. Steam generated in the tubes passes into the front header and into the drums at the top. The upper boiler section is completely enclosed in a heavy jacket, insulated against heat loss.

Boilers are equipped with automatic combustion control, and when so ordered, with instantaneous hot water heater for use with or without a storage tank. A similar boiler, in capacities of 500 sq. ft. to 700 sq. ft., designed to pass through a 20-in. opening, and with 45-in. water line, will be announced by the same manufacturer in the near future.

Dunham Improves Unit Heaters

C. A. Dunham Co., 450 East Ohio St., Chicago, recently announced as successor to its line of V Type unit heaters, the Type V Dwyer unit heater, incorporating a number of improvements in design.

Heating elements, consisting of copper tubes and fins, assembled into bronze castings to form an integral unit, have been designed to eliminate any tendency toward air binding. Seamless drawn copper tubes, streamlined to reduce air resistance, are forced into die-pressed copper sheets, forming the fin surfaces. The supply end of each tube is fitted with a restricting ferrule to assure equalization of the steam pressure throughout the supply header, and the supply and return tappings are located at opposite corners of the element to provide an approximately equal path for the steam from inlet to outlet. A permanently tight bond between tubes and fins is secured by formed collars



Dunham Type V Dwyer unit heater

on the fins, the joints being coated with a high temperature solder.

Fan motor is cradle-mounted in live rubber, preventing transmission of hum or vibration to the casing or piping. The units, while light in weight, are substantially constructed of heavy gauge furniture steel, with solid bar steel trim front and back.

Seven sizes of heater, ranging from 130 sq. ft. to 1100 sq. ft. of equivalent direct radiator, comprise the line. Full descriptions and ratings are contained in the manufacturer's Bulletin 216.

Circulating Room Heaters Burn Oil

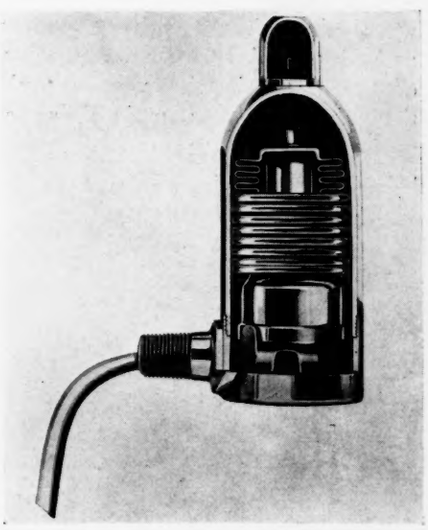
Two models of oil-burning circulating room heaters have been announced by Monitor Utilities Corp., 43-00 Crescent St., Long Island City, N. Y.

Model CH-17 is constructed entirely of steel and has a heating capacity of 3000 cu. ft. A single range burner, 7 in. in diameter, is mounted in an inner fire chamber, vented at the bottom and having stack connection at the rear. Room air is circulated through the cabinet by gravity, entering at the bottom, passing around the outside of the fire chamber, and discharging back into the room through a vented hinged top. Oil reservoir, mounted at the rear, is of 3-gal. capacity. Model CH-27 is similar in construction and design, but operates on two 7-in. range burners.

Valve Permits Vacuum Operation of One-Pipe System

The No. 515 Ideal vacuum valve, recently marketed product of American Radiator Co., 40 West 40th St., New York, is designed to convert a tight one-pipe steam heating plant into a vacuum system, effecting marked savings in fuel consumption.

Air is vented from the system in the usual way, a thermostatically-operated diaphragm acting to force a seating pin into the venting orifice when steam reaches the valve. As the steam pressure starts to fall, air is admitted to a bellows through a



Ideal vacuum valve, No. 515

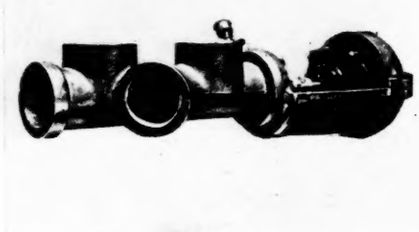
second vent, and the differential of pressure between the bellows and the surrounding valve body holds the seating pin in place, sealing a vacuum within the radiator, which continues to operate at sub-atmospheric pressure.

Johanson Double Circulator

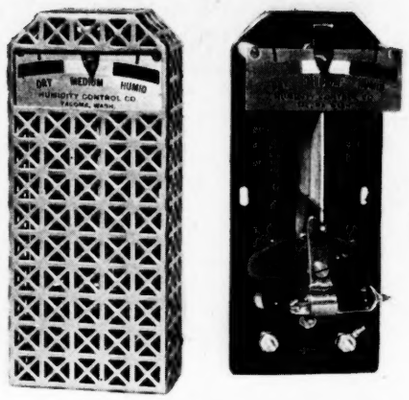
Johanson Water Heater Co., Inc., 1239 Fullerton Ave., Chicago, is marketing the Three Way hot water heating system, incorporating the Johanson double circulator for year 'round hot water supply from the heating boiler.

A single electric motor is direct-connected to two propeller wheels, operating in separate chambers, one of which provides positive circulation of the boiler water in the radiator system, and the other circulates boiler water through the indirect heater. An acquastat on the heating boiler controls the automatic firing device to maintain a temperature of between 160° and 180° in the boiler water at all times, and a room thermostat operates a Minneapolis-Honeywell motorized valve to regulate the flow of water through the building heating system.

For summer operation, an aquastat on the storage tank controls the motor on the double circulator to maintain the desired temperature in the hot water supply. Installed in steam heating systems, the double circulator is used to circulate boiler water through the indirect heater and to provide positive circulation of the water in the storage tank through the heater, maintaining a uniform temperature in the hot water supply at all times.



Double circulator



Goss Humistat

Humidistat Has Unusual Features

Humidity Control Co., 303 Bernice Building, Tacoma, Wash., has revised its line of humidistats to include the Model B-1 Goss Humistat, designed for either wall mounting or for installation within the duct or air conditioning unit.

A plastic hygroscopic element, without spring or other external force exerting against it, tilts a mercury tube switch to control the operation of the humidifying equipment. The element is free to assume its natural form under varying degrees of humidity, a feature claimed by the manufacturer to prevent loss of calibration in use.

Standard finish is dark mahogany, and the cover is latticed to promote free circulation of air to the instrument.

Suction Pressure Limiting Valve on Servel Cooling Units

Humidraft cooling units, marketed by Servel Sales, Inc., Evansville, Ind., are being equipped with a suction pressure limiting valve to prevent the pressure within the unit from falling below a predetermined point when the unit is used in a complicated hook-up and represents only a small part of the load on the compressor. The valve is set to throttle at a given pressure, and as the pressure in the unit increases above this point, the valve is opened against a spring by pressure exerted within a bellows. If a pressure increase is sufficient to actuate the pressure control on the refrigeration machine, the suction pressure will be reduced causing the valve to throttle when the pressure reaches the predetermined point at the valve inlet. This action continues even though the machine is kept in operation by the balance of the cooling units, preventing too great a temperature reduction in the coils.

Develops Unit for Conditioning Air in Automobiles

A compact summer and winter air conditioning unit for installation on passenger automobiles has been developed by the Campbell Metal Window Corp., 100 East 42nd St., New York. The apparatus is suspended beneath the floor of the car and discharges the conditioned air into the passenger space through a floor register.

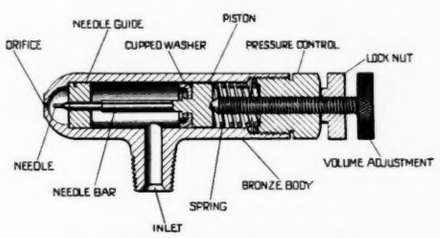
Air is drawn into the unit through a duct, filtered, and passed over the expansion coil of a small refrigerating compressor. During cold weather, the same surface is used to warm the air.

Needle Cleans Spray Orifice

Elliott-Wehner Foundry and Mfg. Co., 7400 Independence Ave., Kansas City, Mo., has developed the 4 in 1 Kant Klog spray nozzle.

Nozzle opening is kept clean and free of obstruction by a needle, automatically moved in and out of the orifice by the pressure of the water in the line. As the water enters through the inlet, it exerts a pressure against the cupped washer in front of the piston, which moves back to draw the needle out of the opening, allowing the water to discharge through the hole. When the water is shut off, the spring forces the piston forward, replacing the needle in the orifice.

Pressure is regulated by adjusting



Kant Klog spray nozzle

the hexagonal pressure control nut, and the operating position of the needle, as adjusted by the knurled screw, regulates the discharge volume. A lock nut maintains this adjustment after the correct setting is made.

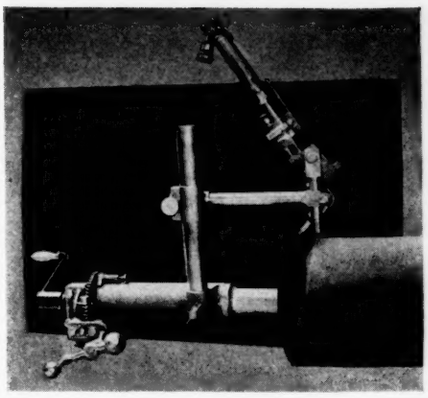
Dole Introduces New Vacuum Valve

Econ-O-Vac No. 100 air and vacuum radiator valves, manufactured by The Dole Valve Co., 1913-1933 Carroll Ave., Chicago, have recently been added to that company's line of heating specialties. The valves are also available in a straight shank model, No. 101, for use on return lines.

When the steam pressure is increasing, the valve serves to vent the air from the system. As the steam enters the valve, a thermostatic fluid sealed within the float exerts a pressure which springs the diaphragm from the concave to convex shape, causing the seating pin to close the vent hole. As the steam pressure decreases, a partial vacuum is induced within the system.

The inside of the bellows is occupied by air at atmospheric pressure at all times, since it is vented independently beyond the closed valve. The differential of pressure between the bellows and the surrounding shell therefore causes the bellows to expand, closing the vent tightly against outside air, and maintaining the vacuum induced within the system.

Dole Econ-O-Vac vacuum valve



Oxweld pipe-cutter

Pipe Cutting Machine Announced

Oxweld pipe-cutting and beveling machines have been added to the line of gas welding equipment manufactured by The Linde Air Products Co., 30 East 42nd St., New York.

This machine is clamped to the pipe by three spreading arms which bear against the inner wall of the pipe. The blowpipe, adjustable for pipe diameter and angle of cut, is supported on an arm which is revolved about the central member of the machine by a hand-turned crank. Blowpipe and arm can be freely rotated without the use of the crank for quick centering of the device.

S-N Announces 1934 Burner

An improved Model CJ oil burner, incorporating numerous refinements and new features of design, has been announced by Scott-Newcomb, Inc., 1934 Pine St., St. Louis. It is of 1½ gal. to 4 gal. capacity, and will handle up to 1000 sq. ft. of radiator surface.

Size of blower has been increased to permit the use of a quiet low-speed motor. Changes have also been made in the material used in the pump gears to further silence operation. The ignition transformer has been removed from beneath the blower housing to a new position above the blower assembly, and all safety controls are now compactly mounted in a single unit attached to the air blast tube.

CO_2 Recorder Utilizes Orsat Principle

A carbon-dioxide indicator and recorder, operating on the Orsat principle, has been developed by The Hays Corporation, Michigan City, Ind.

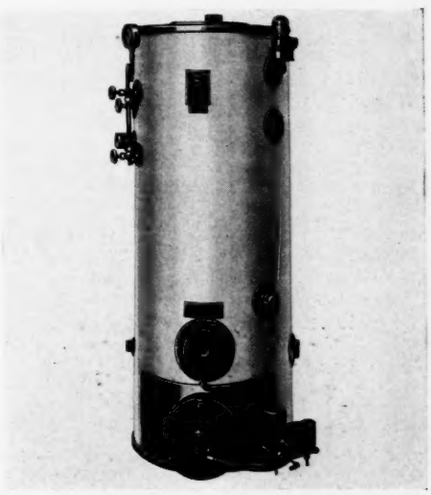
A continuous stream of flue gas is automatically drawn from the last pass of the boiler, and at regular intervals the device takes a measured sample, absorbs the CO_2, and records the amount of absorption. At the same time a pointer indicates on a large scale the CO_2 percentage. The recorder pen and the indicator hold their positions after each analysis, and change the readings only when a change in the CO_2 content occurs. This equipment is also available with over-fire draft and flue gas temperature recording on the same chart. It is suitable for remote mounting.

Motor Wheel Announces Triple-Purpose Boiler

Motor Wheel Corp., Heater Div., Lansing, Mich., recently announced the Model 400A Triple-Purpose automatic burner-boiler unit, for steam and hot water heating and hot water supply.

Boiler is of the vertical flue type, with ten 2½-in. seamless steel tubes welded in place. Boiler shells are of heavy-gauge flanged steel with welded seams, mineral wool insulation being used between the shell and outer jacket.

Boiler capacity is given as 400 sq. ft. of equivalent direct steam radiator, 640 sq. ft. of hot water radiating surface, or 144 gal. per hr. of hot water through a 180° rise.



MW boiler-burner unit

November Degree-Days Bring Season's Total Above Normal

	Atlanta	Baltimore	Birmingham	Boston	Buffalo	Chicago	Cincinnati	Cleveland
Degree-days for November, 1933.....	409	593	329	800	926	813	678	781
Degree-days, Sept. 1, 1933 to Nov. 30, '33	491	831	385	1239†	1468	1238	1004	1180
Degree-days, Sept. 1, 1932 to Nov. 30, '32	664	807	586	1013	1304	1309	1056	1118
Comparison, season to date with last, %	— 26	+ 3	— 34	+ 22	+ 12.5	— 5.4	— 4.9	+ 5.5
Degree-days, Sept. 1 to Nov. 30, Normal	492	790	318	1104	1268	1112	863	1125
Comparison, season to date with nor'l, %	Same	+ 5.2	+ 21	+ 12.2	+ 15.8	+ 11.3	+ 16.3	+ 4.9
Lb. coal per sq. ft. rad., November, 1933	3.272	4.744	2.632	6.400	7.408	6.504	5.424	6.248
Gal. oil per sq. ft. rad., November, 1933.	0.280	0.407	0.226	0.549	0.635	0.557	0.465	0.536
Cu. ft. gas per sq. ft. rad., Nov., 1933....	39.26	56.93	31.58	76.80	88.90	78.05	65.09	74.98

	Davenport	Dayton	Denver	Des Moines	Detroit	Duluth	Fort Wayne	Grand Rapids
Degree-days for November, 1933.....	796	751	565	756	871	1242	823	898
Degree-days, Sept. 1, 1933 to Nov. 30, '33	1228	1178	850	1241	1332	2163	1308	1430
Degree-days, Sept. 1, 1932 to Nov. 30, '32	1381	1124	1237	1508	1292	2167	1361	1390
Comparison, season to date with last, %	— 11.8	+ 4.8	— 31	— 17.7	+ 3.1	Same	— 3.9	+ 2.9
Degree-days, Sept. 1 to Nov. 30, Normal	1158	933	1259	1155	1219	1943	1082	1250
Comparison, season to date with nor'l, %	+ 0.6	+ 26	— 32	+ 7.5	+ 9.3	+ 11.3	+ 20.9	+ 14.4
Lb. coal per sq. ft. rad., November, 1933	6.368	6.008	4.520	6.048	6.968	9.936	6.584	7.184
Gal. oil per sq. ft. rad., November, 1933.	0.546	0.515	0.387	0.518	0.597	0.852	0.564	0.616
Cu. ft. gas per sq. ft. rad , Nov., 1933....	76.42	72.10	54.24	72.58	83.62	119.23	79.01	86 21

	Harrisburg	Hartford	Indianapolis	Kansas City	La Crosse	Los Angeles	Louisville	Memphis
Degree-days for November, 1933.....	749	819	732	537	958	84	605	367
Degree-days, Sept. 1, 1933 to Nov. 30, '33	1144	1278	1088	784	1572	174	848	478
Degree-days, Sept. 1, 1932 to Nov. 30, '32	1065	1146	1205	1098	1753	44	937	676
Comparison, season to date with last, %	+ 7.4	+ 11.5	— 9.7	— 29	— 10.3	+ 296	— 9.5	— 29
Degree-days, Sept. 1 to Nov. 30, Normal	989	1097	985	826	1467	123	738	464
Comparison, season to date with nor'l, %	+ 15.7	+ 16.5	+ 11.5	— 5.1	+ 7.2	+ 41.5	+ 14.9	+ 3.0
Lb. coal per sq. ft. rad., November, 1933	5.992	6.552	5.856	4.296	7.664	0.672	4.840	2.936
Gal. oil per sq. ft. rad., November, 1933.	0.514	0.562	0.502	0.368	0.657	0.058	0.415	0.252
Cu. ft. gas per sq. ft. rad , Nov., 1933....	71.90	78.62	70.27	51.55	91.97	8.06	58.08	35.23

	Milwaukee	Minneapolis	New Haven	New Orleans	New York	Omaha	Peoria	Philadelphia
Degree-days for November, 1933.....	891	1028	771	90	698	687	765	627
Degree-days, Sept. 1, 1933 to Nov. 30, '33	1390	1636	1177	95	1017	1081	1198	873
Degree-days, Sept. 1, 1932 to Nov. 30, '32	1468	1745	1072	302	929	1317	1349	795
Comparison, season to date with last, %	— 5.3	— 10.2	+ 9.8	— 69	+ 9.5	— 17.9	— 11 2	+ 9.8
Degree-days, Sept. 1 to Nov. 30, Normal	1380	1537	1092	102	894	1109	1173	830
Comparison, season to date with nor'l, %	+ 1.0	+ 6.5	+ 7.8	— 6.9	+ 13.8	— 2.5	+ 6.8	+ 4.9
Lb. coal per sq. ft. rad., November, 1933	7.128	8.224	6.168	0.720	5.584	5.496	6.120	5.016
Gal. oil per sq. ft. rad., November, 1933.	0.611	0.705	0.529	0.062	0.479	0.471	0.525	0.430
Cu. ft. gas per sq. ft. rad , Nov., 1933....	85.54	98.69	74.02	8.64	67.01	65.95	73.44	60.19

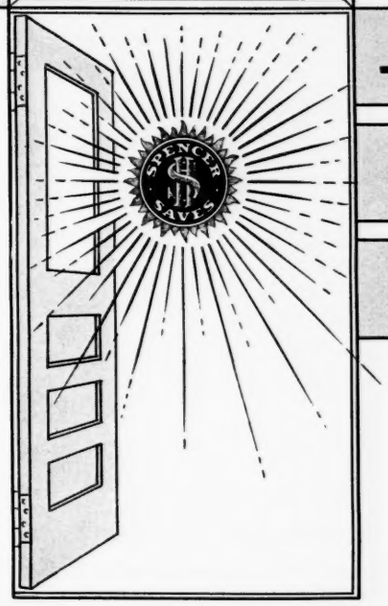
	Pittsburgh	Portland, Ore.	Providence	Reading	Rochester	St. Louis	Salt Lake City	San Francisco
Degree-days for November, 1933.....	762	553	789	649	899	576	654	155
Degree-days, Sept. 1, 1933 to Nov. 30, '33	1129	968	1238	1007	1457	829	897	414
Degree-days, Sept 1, 1932 to Nov. 30, '32	1085	800	1092	1052	1308	997	1064	352
Comparison, season to date with last, %	+ 4.1	+ 21	+ 13.4	— 4.3	+ 11.4	— 16.9	— 15.7	+ 17.6
Degree-days, Sept. 1 to Nov. 30, Normal	982	995	1103	1013	1289	802	1129	521
Comparison, season to date with nor'l, %	+ 15	— 2.7	+ 12 2	— 0.6	+ 13.0	+ 3 4	— 20.6	— 20.5
Lb. coal per sq. ft. rad., November, 1933	6.096	4.424	6 312	5.192	7.192	4.608	5.232	1.240
Gal. oil per sq. ft. rad., November, 1933.	0.523	0.379	0.541	0.445	0.616	0 395	0.448	0.106
Cu. ft. gas per sq. ft. rad , Nov., 1933....	73.15	53.09	75.74	62.30	86.30	55.30	62.78	14.88

	Scranton	Seattle	Spokane	Syracuse	Toledo	Trenton	Washington, D. C.	Wichita
Degree-days for November, 1933.....	826	547	780	924	836	716	600	470
Degree-days, Sept. 1, 1933 to Nov. 30, '33	1361	1115	1442	1486	1308	1086	885	650
Degree-days, Sept 1, 1932 to Nov. 30, '32	1270	968	1330	1272	1320	977	866	976
Comparison, season to date with last, %	+ 7.2	+ 15.2	+ 8.4	+ 16.8	— 0.9	+ 11.2	+ 2.2	— 33
Degree-days, Sept. 1 to Nov. 30, Normal	1189	1165	1526	1319	1110	830	845	828
Comparison, season to date with nor'l, %	+ 14.5	— 4.3	— 5.5	+ 12.7	+ 17.8	+ 18.8	+ 4.7	— 21.6
Lb. coal per sq. ft. rad., November, 1933	6.608	4.376	6.240	7.392	6.688	5.728	4.800	3.760
Gal. oil per sq. ft. rad., November, 1933.	0.566	0.375	0.535	0.634	0.573	0.491	0.411	0.322
Cu. ft. gas per sq. ft. rad , Nov., 1933....	79.30	52.51	74.88	88.70	80.26	68.74	57.60	45.12

†*Boston degree-days for October were* 439 *and not* 429 *as reported here last month.*

Fuel consumption figures given above are based on certain conditions, and for other conditions corrections must be made. The figures assume the use of steam radiators emitting 240 B.t.u. per sq. ft. per hr., a system operating at 100% efficiency, and radiators calculated for maintaining 70° in zero weather. Heating values assumed for the fuels are 12,000 B.t.u. per lb. for coal, 1000 B.t.u. per cu. ft. for gas, and 140,000 B.t.u. per gal. for oil. To correct for other heating values, efficiencies, and design conditions, follow the method explained in the "Heating and Ventilating Degree-Day Handbook."

Looking into 1934 -and what it holds for You



Mr. Heating Contractor:

WE want to make our greeting to you for the New Year, something MORE than merely the customary cordial good wishes.

We prefer to present what we believe are some concrete evidences that 1934 *will be* a BETTER YEAR. Also, to mention briefly some of the things that Spencer is doing and will do, to help MAKE it a better year for you, as well as for ourselves.

Here are some of the favorable factors for heating contractors that we can see for 1934:

Encouraging reports of general business improvement; a very extensive Public Works program; a rapidly increasing number of obsolete and inefficient boilers that soon will HAVE to be replaced; a steadily growing public interest in Automatic Heat at low cost, and more stabilized trade conditions that mean more profitable business.

We do NOT believe that heating contractors who sit back and depend on these favorable factors ALONE, will see very much improvement. You can't expect the winds to drive your ship forward, if you don't hoist the sails. It is going to take a great deal of hard work and careful planning. We believe this applies to us as much as to you.

That is why Spencer is putting forth even greater efforts; designing new products to meet new conditions; planning further sales co-operation for the heating contractor; so that both of us can get the fullest benefit from the more promising conditions.

Details of Spencer's 1934 program will be announced during the months to come. We invite you to watch for and take advantage of them.

Very truly yours,
C. N. TULL, *President*

SPENCER HEATER COMPANY, Williamsport, Pa.
Division of Cord Corporation
BRANCHES IN PRINCIPAL CITIES
The Spencer Foundry Company, Ltd., Penetanguishene, Ontario and Montreal, Quebec, Canada

SPENCER BOILERS
for steam, vapor or hot water

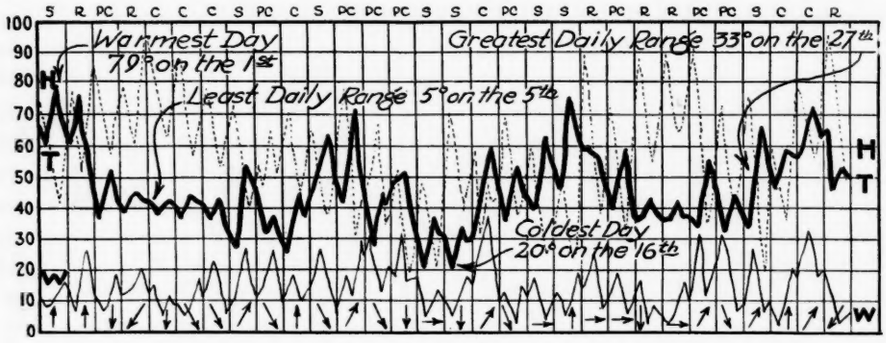
SPENCER MAGAZINE FEED BOILERS
Cast Iron Sectional
Capacities, 175 to 3,250 sq. ft.
Steel Tubular
Capacities, 275 to 16,400 sq. ft.

SPENCER OIL BURNING
Steel Tubular Boilers
Capacities, 2,250 to 40,000 sq. ft.

SPENCER STOKER BOILER UNITS
Steel Tubular Boiler
and Stoker, built as a unit,
automatically controlled
Capacities, 2,250 to 40,000 sq. ft.

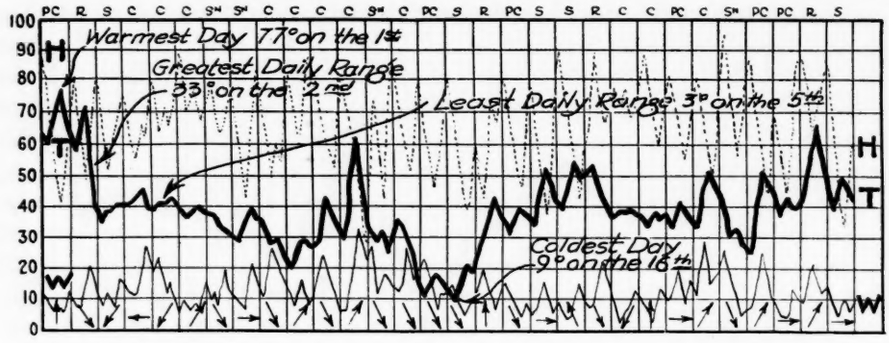
THE WEATHER FOR NOVEMBER, 1933

Plotted from records especially compiled for HEATING AND VENTILATING by the U. S. Weather Bureau. Heavy curves (T), temperatures in deg. F.; dotted lines (H), per cent relative humidity, from readings at 8 a.m., noon, and 8 p.m., except for New York, which shows hourly readings. Light lines (W), wind velocity in m.p.h. Arrows indicate prevailing wind directions. S—clear; PC—partly cloudy; C—cloudy; R—rain; Sn—snow.



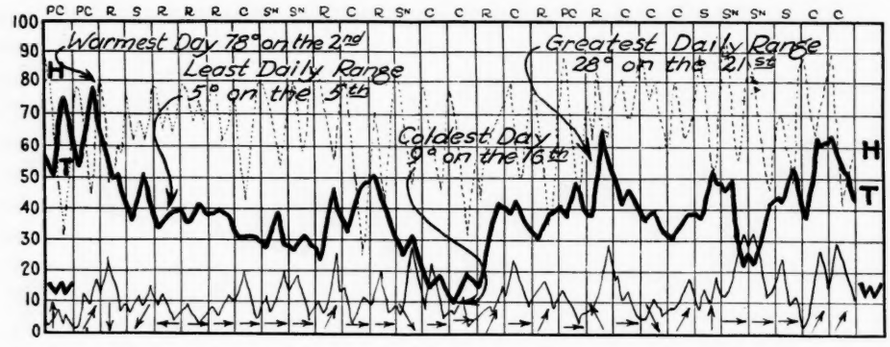
St. Louis

Mean temp. for month, 46.0°; aver. wind velocity, 13.1 m.p.h.; prevailing direction of wind, N.W.



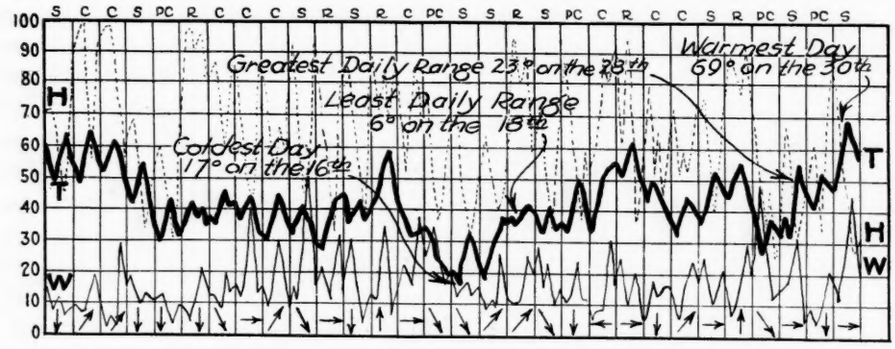
Chicago

Mean temp. for month, 38.0°; aver. wind velocity, 12.5 m.p.h.; prevailing direction of wind, N.W.



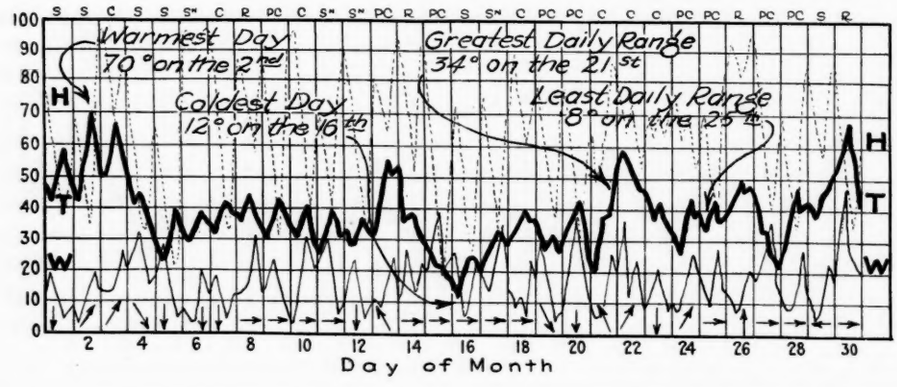
Pittsburgh

Mean temp. for month, 39.6°; aver. wind velocity, 10.4 m.p.h.; prevailing direction of wind, W.



New York

Mean temp. for month, 41.8°; aver. wind velocity, 15.6 m.p.h.; prevailing direction of wind, W.


Warmest Day 70° on the 2nd
Greatest Daily Range 34° on the 21st
Coldest Day 12° on the 16th
Least Daily Range 8° on the 25th
H
T
W
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30
Day of Month

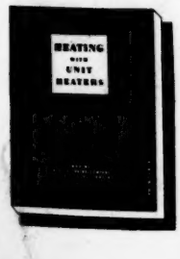
Boston

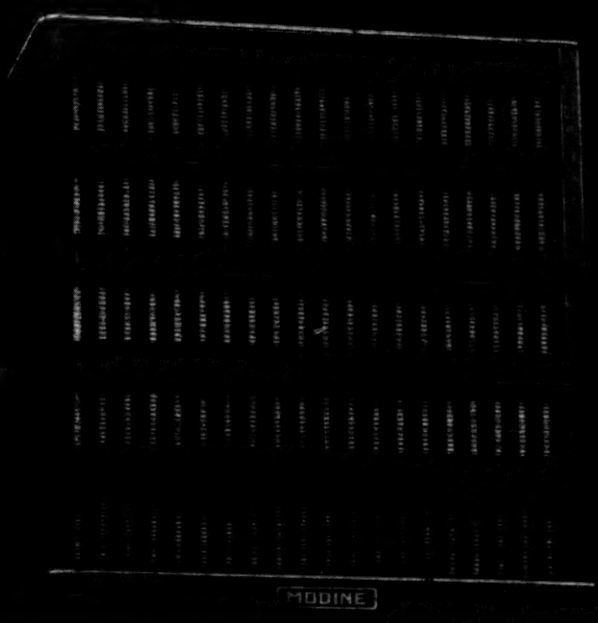
Mean temp. for month, 38.3°; aver. wind velocity, 15.1 m.p.h.; prevailing direction of wind, W.

THE *New* MODINE Unit Heaters

SIXTEEN STEAM AND

• **Entirely New Design**...a strikingly handsome unit, lighter in weight, with far greater structural strength. • **New Velocity Generators** direct and control the air stream...an exclusive Modine feature. • **New Expansion Bend Construction** permits condenser tubes to expand individually and differentially . . . an exclusive Modine development. • **New Bonding Process** enhances heat transfer from tube to fin. • **New Streamline Design Re-Adjustable Deflectors.** • **New Improved Performance** . . . far more effective and economical heat distribution.



New **FREE BOOK**

Just off the press—"Heating With Unit Heaters"—32 pages of interesting and valuable information, informative drawings and photographs . . . for architects, contractors and engineers. *Write for it today...no cost, no obligation.*